

**Aryabhata Institute of Technology  
G.T.Karnal Road, Delhi-110033.**



**Syllabus  
(I TO VI SEM)**

**New Scheme: wef-2014**

**DIPLOMA IN  
MECH.ENGG. / MECH.(MAINT)ENGG.**

**Study Scheme (wef 2014)**  
**FIRST SEMESTER MECH.ENGG.& /MECH.(MAINT)ENGG.**

Code No.	Subject	Study Scheme Period/Week			Evaluation Scheme						Total Marks
		L	T	P	Internal Assessment		External Assessment Exam				
					Theory	Practical	Written Paper		Practical		
					Max. Marks	Max. Marks	Max. Marks	Hrs.	Max. Marks	Hrs.	
*CM-102	Communication Skills - I	4	1	2	50	50	100	3	100	-	300
*BS-112	Applied Mathematics-I	4	2	-	50	-	100	3	-	-	150
*ES-121	Engineering Drawing-I	2	-	6	-	50	100	3	-	-	150
*BS-213	Applied Physics	4	2	2	50	50	100	3	100	3	300
*CE-130	Workshop Practice-I	-	-	8	-	50	-	-	100	3	150
**	Student Centered Activities	-	-	5	-	-	-	-	-	-	-
	<b>TOTAL</b>	<b>14</b>	<b>5</b>	<b>23</b>	<b>150</b>	<b>200</b>	<b>400</b>	<b>-</b>	<b>300</b>	<b>-</b>	<b>1050</b>

**CM-102 ENGLISH AND COMMUNICATION SKILLS – I**

L      T      P  
4      1      2

**Rationale**

The curriculum aims to develop the use of English for three major purposes social interaction, academic achievement and professional use. Listening, speaking, reading, and writing skills can not be thought of as independent skills. They are generally perceived as interdependent where one skill often activates the other skills as well as the paralinguistic skills required for the achievement of effective communication. It is believed that the most effective way to achieve these purposes is through the adoption of a thematic, integrated, content-based approach to teaching and learning.

**DETAILED CONTENTS**

**1. INTRODUCTION (10%)**

**Theory:**

Definition, Introduction and Process of Communication

- Objectives of Communication
- Essentials of Communication
- Media and Modes of Communication
- Channels of Communication
- Barriers to Communication
- Body language
- Humour in Communication
- Silence in Communication

**Note:** Teachers are expected to give practical examples, while teaching above topics

**2. LISTENING (10%)**

**Theory:** Significance, essentials, barriers and effectiveness of Listening.

**Practicals:** The following exercises to be conducted in practical sessions:

- Using pre-recorded CDs/DVDs with pre-listening exercise to prepare students about what they are going to hear and comprehension based on the audio
- Note-taking
- Listening for the main ideas

- Assessing listening proficiency

### 3. **SPEAKING** (20%)

**Theory:** Significance, essentials, barriers and effectiveness of Speaking

- Introduction to phonetics (Dictionary: meaning and pronunciation of words as given in the standard dictionary using symbols of phonetics)

**Practicals:** The following exercises to be conducted in practical sessions:

- Exercises on pronunciation of common words as given in the standard dictionary using symbols of phonetics
- Greetings for different occasions
- Introducing oneself, others and leave taking (talking about yourself)
- Just a minute (JAM) sessions: Speaking extempore for one minute on given topics
- Paper reading before an audience (reading unseen passages)
- Situational Conversation/role-playing with feedback, preferably through video recording
- Reading aloud of Newspaper headlines and important articles
- Improving pronunciation through tongue twisters

### 4. **READING** (10%)

**Theory:**

- Techniques of reading: Skimming, Scanning, Intensive and Extensive Reading
- Comprehension, Vocabulary enrichment and grammar exercises based on the following selective readings:

#### **Section-I**

- Homecoming – R.N. Tagore
- The Selfish Giant - Oscar Wilde
- The Stick – Justice Surinder Singh

#### **Section-II**

- I Have A Dream – Martin Luther King
- My struggle for An Education- Booker T Washington
- Life Sketch of Sir Mokshagundam Visvesvarayya

#### **Section-III**

- Ozymandias – P.B. Shelley
- Daffodils – William Wordsworth
- Stopping by Woods on a Snowy Evening – Robert Frost
- Comprehension exercises on unseen passages
  - Exercises on interpretation of tables, charts, graphs, signs and pictures etc.

**Practicals:**

- Paper reading
- Poetry recitation
- Reading newspaper headlines

### 5. **WRITING** (15%)

**Theory:**

- Significance, essentials and effectiveness of writing
- Paragraph of 100-120 words

**Practicals:**

- Exercises on spellings
- Group exercises on writing paragraphs on given topics

### 6. **VOCABULARY** (15%)

**Theory:**

- Vocabulary of commonly used words
- Pair of words (Words commonly confused and misused)

**Practicals:**

- To look up words in a Dictionary: meaning and pronunciation of words as given in the standard dictionary using symbols of phonetics
- To seek information from an Encyclopedia

### 7. **GRAMMAR** (20%)

**Theory:**

- Identification of parts of speech
- Using a word as different parts of speech
- Correction of in-correct sentences
- Tenses
- Voice

**Note:** Teachers are expected to give practical examples, while teaching above topics

### **RECOMMENDED BOOKS**

1. Text Book of English and Communication Skills Vol – 1, By Alvinder Dhillon and Parmod Kumar Singla; Published by: M/S Abhishek Publications, Chandigarh
2. Spoken English (2<sup>nd</sup> Edition) by V Sasikumar & PV Dhamija; Published by Tata MC Graw Hills, New Delhi.
3. Spoken English by MC Sreevalsan; Published by M/S Vikas Publishing House Pvt. Ltd; New Delhi.
4. Spoken English –A foundation course (Part-I & Part-II) By Kamlesh Sdanand & Susheela Punitha; Published by Orient BlackSwan, Hyderabad
5. Practical Course in English Pronunciation by J Sethi, Kamlesh Sadanand & DV Jindal; Published by PHI Learning Pvt. Ltd; New Delhi.
6. A Practical Course in Spoken English by JK Gangal; Published by PHI Learning Pvt. Ltd; New Delhi.
7. English Grammar, Composition and Usage by NK Aggarwal and FT Wood; Published by Macmillan Publishers India Ltd; New Delhi.
8. Business Correspondence & Report writing (4<sup>th</sup> Edition) by RC Sharma and Krishna Mohan; Published by Tata MC Graw Hills, New Delhi.
- 9.
10. Business Communication by Urmila Rani & SM Rai; Published by Himalaya Publishing House, Mumbai.
11. Business Communication Skills by Varinder Kumar, Bodh Raj & NP Manocha; Published by Kalyani Publisher, New Delhi.
12. Professional Communication by Kavita Tyagi & Padma Misra; Published by PHI Learning Pvt. Ltd; New Delhi.
13. Business Communication and Personality Development by Bsiwajit Das and Ipseeta Satpathy; Published by Excel Books, Delhi
14. Succeeding Through Communication by Subhash Jagota; Published by Excel Books, Delhi
15. Communication Skills for professionals by Nira Konar; Published by PHI Learning Pvt. Ltd; New Delhi.
16. Developing Communication Skills (2<sup>nd</sup> Edition) by Krishna Mohan & Meera Banerji; Published by Macmillan Publishers India Ltd; New Delhi.
17. Effective Technical Communication By M .Ashraf Rizwi; Published by Tata MC Graw Hills, New Delhi.
18. Basic Communication Skills for Technology by Andrea J Rutherford; Published by Pearson Education, New Delhi
19. English & Communication Skills for students of Science & Engineering by SP Dhanavel; Published by Orient BlackSwan, Hyderabad.
20. Technical Communication- Principles & Practices by Meenakshi Raman & Sangeetha Sharma; Published by Oxford University Press, New Delhi.
21. Technical English by S. Devaki Reddy & Shreesh Chaudhary; Published by Macmillan Publishers India Ltd; New Delhi.
22. Advanced Technical Communication, by Kavita Tyagi & Padma Misra; Published by PHI Learning Pvt. Ltd; New Delhi.
23. Communication Skills for Engineer & Scientist by Sangeeta Sharma & Binod Mishra; Published by PHI Learning Pvt. Ltd; New Delhi.

### **BS-112 \*APPLIED MATHEMATICS – I**

<b>L</b>	<b>T</b>	<b>P</b>
<b>4</b>	<b>2</b>	<b>-</b>

#### **RATIONALE**

The course aims at developing analytical abilities in basics of applied mathematics such as: vector algebra, matrices, elementary numerical analysis, coordinate geometry, differential and integral calculus and solution of first order differential equations. Besides application of above the elements in engineering, the course of study will also provide continuing education base to them.

**NOTE: Weightage of each topic for external examination is given in the brackets**

#### **DETAILED CONTENTS**

1. **ALGEBRA** (15%)
  - (i) Arithmetic Progression (A.P.) – its  $n^{\text{th}}$  term, sum to  $n$  terms. Geometric Progression (G.P.) - its  $n^{\text{th}}$  term, sum to  $n$  terms. And infinite Geometric series. Partial Fractions.
  - (ii) Binomial theorem for positive integral index (without proof), Binomial theorem for any index, Expansions.
2. **TRIGONOMETRY** (15%)
  - (i) Sum and difference formulas for trigonometric ratios of angles and their application (without proof). Formula from product to sum, difference and vice-versa. Ratio of multiple angles, sub multiple angles (like  $2A$ ,  $3A$ ,  $A/2$ ).
  - (ii) In a triangle sine formulas, cosine formulas, Napier's analogy. Solution of triangle.
  - (iii) Simple problems on height and distance.
  - (iv) Plotting of curves  $y = f(x)$ ,  $f(x)$ , trigonometric functions ( Sine, Cosine, Tangent).

**COORDINATE GEOMETRY (40%)**

- (i) Equation of straight line in various standard forms. Intersection of two straight lines and angle between them. Concurrent lines, perpendicular distance formula.
- (ii) General equation of a circle and its characteristics. Equation of a circle given center and radius, three point form and diametrical form.
- (iii) Definition of a conic section, standard equation of a parabola equation of parabola given its focus and Directrix. Given the equation of parabola finding its focus axis, vertex, Directrix and latus section.
- (iv) Ellipse and hyperbola (standard equation, without derivation) determining the equation of ellipse and hyperbola given the Directrix, focus and eccentricity. Given the equation of the ellipse and hyperbola finding the foci, Directrices, axes, latus rectum, vertex and eccentricity.

**4. VECTOR ALGEBRA (10%)**

- (i) Concept of a vector, Position vector of a point. Addition and subtraction of vectors.
- (ii) Multiplication of a vector by a scalar product and vector product of two vectors. Application to problems on work done and moment (torque)

**5. DETERMINANT AND MATRIX (20%)**

- (i) Definitions Evaluation of a determinant of order two and three. Minor and cofactors. Properties of determinants. Solving simultaneous equations by Cramer's rule.
- (ii) Concept of a matrix, definitions, Transpose of a matrix, Symmetric and Skew Symmetric matrix, Diagonal matrix, Unit matrix, Addition and Multiplication of matrices, Adjoint and Inverse of a matrix, solving simultaneous equations by matrix methods.

**ES – 121 ENGINEERING DRAWING**

L	T	P
2	-	6

**RATIONALE**

Drawing is the language of engineers & technicians. Reading & interpreting engineering drawing is their day to day responsibility. The course is aimed at in developing basic graphic skills so as to enable them to use these skills in preparation of engineering drawings their reading & interpretation. The emphasis while imparting instruction should be to develop conceptual skills in the students.

**NOTE:-**

1. **Weightage of each topic for external examination is given in the brackets.**
2. **First angle projection to be followed.**
3. **Minimum of 12 sheets to be prepared by each student.**
4. **BIS SP 46 – 1988 should be followed.**

**DETAILED CONTENTS****1. INTRODUCTION (5%)**

- Drawing instruments & their uses.
- Lines, lettering & dimensioning.

**2. SCALES (10%)**

- Types of scales, plain scale, diagonal scale, vernier scale.

**3. PROJECTION OF POINTS AND LINES (20%)****First angle and Third angle projections**

Projection of Points : Introduction, Points situated in 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> quadrants. Projection of Lines: Introduction, Line parallel to one or both the planes, Line contained by one or both the planes, line parallel to one of the plane. Line inclined to one plane and parallel to others, Line inclined to both the planes.

**4. THEORY OF PROJECTIONS (elaborate theoretical instruction) (15%)**

- Introduction to first angle projections
- Drawing 3 views of given objects (at least 2 objects)
- Drawing 6 views of given objects (Non symmetrical objects may be selected for this exercise)
- Identification of surfaces on drawn views & objects drawn.
- Exercises on missing surfaces & views
- Sketching practice of pictorial view from objects

**4. SECTION (20 %)**

Section planes, true shape of a section

**Section of prism**

- a) Section plane parallel to VP
- b) Section plane parallel to HP

**Section of pyramids**

- a) Section plane parallel to base of pyramid
- b) Section plane parallel to VP

**Section of cylinder**

- a) Section plane parallel to the base
- b) Section plane parallel to the axis

Importance & salient features, methods of representing sections, classification of section, conventions in sectioning.

Drawing of full section, half section, partial or broken out section, offset sections, revolved sections & removed sections. Exercises on sectional views of different objects.

Drawing of different conventions for materials in sections. Conventional breaks for shafts, pipes: Rectangular /square/circular, angle, channel and Rolled sections.

**5. ISOMETRIC VIEWS (15%)**

- Fundamentals of isometric projections (theoretical instructions)

1. Setting an OHP lenses and mirrors for its best performance.

- Isometric views from 2 or 3 given orthographic views

**6. Symbols, Conventions and simple drawing (10%)**

- a) Civil Engineering: Sanitary fitting symbols.
- b) Electrical fittings: Symbols for domestic interior installations.
- c) Building plan drawing with Electrical and Civil Engineering symbols.

**REFERENCES**

1. Engg. Drawing A Text Book of Engineering Drawing By Surjit Singh Dhanpat Rai & co.
2. Engineering drawing –planes & solid geometry ND Bhatt, V.M. Panchal Charotar publisher home

**BS-213 \*APPLIED PHYSICS**

L	T	P
4	2	2

**RATIONALE**

Applied physics is a foundation course. Its purpose is to develop proper understanding of physical phenomenon and scientific temper in the students. The course covers basics like Mechanics, Heat, Sound and Light.

**DETAILED CONTENTS**

**1. Measurement (20%)**

**(i) Units and Dimensions**

Fundamental and derived units, SI units, dimensions of physical quantities, dimensional formula and dimensional equation, principles of homogeneity of dimensions and applications of homogeneity principle in:

- a) Checking the correctness of physical equation.
- b) Deriving relations among various physical quantities.
- c) Conversion of numerical values of physical quantities from one system of units into other system.

**(ii) Errors in measurement accuracy, estimation of percentage error in the result of measurement.**

**2. Waves (20%)**

Generation of waves by vibrating particles, progressive wave, equation of waves, energy transfer by particles and waves, superposition of waves and its applications to interference, beats and stationary waves (graphical); sound and light as wave – range of frequencies, wavelengths, velocities and their nature, electromagnetic spectrum.

3. **Sound** (15%)
- (i) **Acoustics**  
Reflection, refraction and absorption of sound waves  
by materials; definition of pitch, loudness, quality and intensity of sound waves, units of intensity (bel and decibel); Echo and reverberation and reverberation time, control of reverberation time. Acoustic insulation (qualitative treatment only of reverberation).
- (ii) **Ultrasonic**  
Production of ultrasonic waves by magnetostriction and piezoelectric effect, detection and properties of ultrasonic; applications to drilling, cold welding, cleaning, flaw detection and exploration (sonar).
4. **Light; Geometrical Optics:** (20%)  
Defect in image formation, eyepieces construction and principles of preparation of telephoto and zoom lens, principle of optical projectors, optical principles of OHP and slide film projectors.
5. **Laser and its Applications** (15%)  
Laser principle, types of Lasers; detailed study of the He-Ne and Ruby lasers and their applications. Fluorescent tube; mercury arc light, xenon source, sodium lamp.
6. **Radioactivity and Detection of Radiations** (10%)  
Natural radioactivity; half-life; decay constant; mean life; radioactive transformation. Principles of nuclear fission and fusion; energy generation. Source of background radiations; health Hazards of radiations. Units of radiation.

#### LIST OF PRACTICALS

2. Use of Vernier calipers and micrometer for determination of diameter of a wire.
3. Study of resonance in air column and determination of velocity of sound in air.
4. To make a telescope by combination of suitable lenses and determine its magnifying power.
5. To make a compound microscope by suitable combination of lenses and determine its magnifying power.
6. Determination of wavelength of various spectral lines of mercury lamp.
7. Measurement of illumination level of a white surface under: natural daylight, incandescent light and fluorescent light.
8. To compare the intensity of illumination by Bunsen's photometer.
9. Study of diffraction of He-Ne laser beam by markings on a Vernier scale and determination of its wavelength.
10. To measure the first ionization potential of Hg using a diode.

#### SUGGESTIONS

While teaching the subject, teacher should make maximum use of demonstration to make the subject interesting to the students.

#### CE-230 GENERAL WORKSHOP PRACTICE – I

L	T	P
-	-	8

#### RATIONALE

In order to have a balanced overall development of diploma engineers, it is necessary to integrate theory with practice. General workshop practices are included in the curriculum in order to provide hand on experience about use of different tools and basic manufacturing practices. This course aims at developing general manual and machining skills in the students. Besides above, the development of dignity of labour, precision, safety at work place, team working and development of right attitude are the other objectives.

#### DETAILED CONTENTS (PRACTICAL EXERCISES)

**Note:** The students are supposed to come in proper workshop dress prescribed by the institute. Wearing shoes in the workshop(s) is compulsory. Importance of safety and cleanliness, safety measures and upkeep of tools, equipment and environment in each of the following shops should be explained and practiced. The students should prepare sketches of various tools/jobs in their practical Notebook.

The following shops are included in the syllabus:

1. **Carpentry Shop-1**
2. **Painting Shop-1**
3. **Fitting Shop -I**
4. **Welding Shop-I**
5. **Smithy Shop**
6. **Sheet Metal Shop**

## 1. Carpentry Shop – I

- 1.1 Safety precautions in carpentry shop
- 1.2 Introduction to various types of wood such as Deodar, Kail, Partal, Teak, Mango, Sheesham, etc. (Demonstration and their identification).
- 1.3 Demonstration, function and use of commonly used hand tools. Care, maintenance of tools and safety measures to be observed.
  - Job I Marking, sawing, planing and chiseling & their practice (size should be mentioned)
- 1.4 Introduction to various types of wooden joints, their relative advantages and uses.
  - Job II Preparation of half lap joint
  - Job III Preparation of Mortise and Tenon Joint

## 2. Painting Shop- I

- 2.1 Demonstration of various methods of painting wooden items.
- 2.2 Introduction to various types of paints and safety precaution observed in painting shop
  - Job I Preparation of wooden surface before painting including primer coating
  - Job II Painting Practice by brush/spray

## 3. Fitting Shop

- 3.1 Introduction to fitting shop tools, common materials used in fitting shop, Identification of materials. Such as Steel, Brass, Copper, Aluminium etc. Identification of various sections of steel such as Flat, Angle, Tee, Channel, Bar Girder, Square, Z-Section, etc.
- 3.2 Description and demonstration of various types of work benches, holding devices and files. Precautions while filing.
- 3.3 Description and demonstration of simple operation of hack-sawing, demonstration and description of various types of blades and their specifications, uses and method of fitting the blade.
  - Job I Marking of job, use of marking tools and measuring instruments.
  - Job II Filing a dimensioned rectangular or square piece of an accuracy of  $\pm 0.5\text{mm}$ .
  - Job III Filing practice (production of flat surfaces). Checking by straight edge.
- 3.1 Care and maintenance of measuring tools like calipers, steel rule, try square, vernier calipers, micrometer, height gauge, combination set.

## 4. Welding Shop – I

- 4.1 (a) Introduction to welding and its importance in engineering practice; types of welding; common materials that can be welded, introduction to welding equipment e.g. a.c. welding set, d.c. rectifier, electrode holder, electrodes and their specifications, welding screens and other welding related equipment, accessories and gloves.
  - (b) Safety precautions during welding
  - (c) Hazards of welding and its remedies
- 4.2 Electric arc welding, (a.c. and d.c.) precautions while using electric arc welding, Practice in setting current and voltage for striking proper arc. Earthing of welding machine.
  - Job I Practice of striking arc bending and tacking while using electric arc welding set.
  - Job II Welding practice on electric arc welding for making uniform and straight weld beads
- 4.3 Various types of joints and end preparation.
  - Job III Preparation of butt joint by electric arc welding.
  - Job IV Preparation of corner joint by using electric arc welding.

## 5. Smithy Shop

- 5.1 Demonstration and detailed explanation of tools and equipment used. Forging operations in smithy shop. Safety measures to be observed in the smithy shop.
- 11 5.2 Demonstration and description of bending operation, upsetting operation, description and specification of anvils, swage blocks, hammers etc.
- 5.3 Demonstration and description of tongs, fullers, swages etc.
  - Job I To forge a L-hook.
  - Job II To prepare a job involving upsetting process
  - Job III To forge a chisel
  - Job IV To prepare a cube from a M.S. round by forging method.



## 6. Sheet Metal Shop

Introduction to sheet metal shop, use of hand tools and accessories e.g. different types of hammers, hard and soft mallet, sheet and wire gauge, necessary allowance required during job fabrication, selection of material and specifications.

- 6.1 Introduction and demonstration of hand tools used in sheet metal shop.
- 6.2 Introduction and demonstration of various machines and equipment used in sheet metal shop e.g. shearing machine, bar folder, burring machine, power press, sheet bending machine.
- 6.3 Introduction and demonstration of various raw materials used in sheet metalshop e.g. M.S. sheet, galvanized-iron plain sheet, galvanised corrugated sheet, aluminium sheets etc.
- 6.4 Study of various types of rivets, steel screw etc.
  - Job I Shearing practice on a sheet using hand shears.
    - a) Practice on making single riveted lap joint/double riveted lap Joint.
    - b) Practice on making single cover plate chain type, seam joint and riveted butt joint

### RECOMMENDED BOOKS

1. Workshop Technology I,II,III, by S K Hajra, Choudhary and A K Chaoudhary; Media Promoters and Publishers Pvt. Ltd., Bombay
2. Workshop Technology by Manchanda Vol. I,II,III; India Publishing House, Jalandhar.
3. Manual on Workshop Practice by K Venkata Reddy, KL Narayana et al; MacMillan India Ltd. New Delhi
4. Basic Workshop Practice Manual by T Jeyapoovan; Vikas Publishing House (P) Ltd., New Delhi
5. Workshop Technology by B.S. Raghuwansh;, Dhanpat Rai and Co., New Delhi
6. Workshop Technology by HS Bawa; Tata McGraw Hill Publishers, New Delhi.

# MECH. ENGG. / MECH. MAINT. ENGG. SECOND SEMESTER

## 2014 SCHEME

Code No.	Subject	Study Scheme Period/Week			Evaluation Scheme						Total Marks
		L	T	P	Internal Assessment		External Assessment Exam				
					Theory	Practical	Written Paper		Practical		
					Max Marks	Max. Marks	Max. Marks	Hrs.	Max. Marks	Hrs.	
BS-212	* Applied Mathematics-II	4	2	-	50	-	100	3	-	-	150
ES-221	* Engineering Drawing-II	2	-	6	-	50	100	3	-	-	150
ES-122	* Basics of Information Technology	-	-	4	-	50	-	-	100	3	150
ES-120	* Applied Mechanics	4	2	2	50	50	100	3	100	3	300
BS-214	* Applied Chemistry	4	-	2	50	50	100	3	100	3	300
	* Workshop Practice-II	-	-	8	-	50	-	-	100	3	150
**	Student Centered activities	-	-	-	-	-	-	-	-	-	-
	TOTAL	14	4	22	-	-	-	-	-	-	1200

### BS-212 \*APPLIED MATHEMATICS-II

L T P  
4 2 -

#### 1. DIFFERENTIAL CALCULAS. (40%)

(i) Functions, concept of evaluation of following limits.

$$\lim_{x \rightarrow 0} \frac{\sin x}{x}, \quad \lim_{x \rightarrow a} \frac{x^n - a^n}{x - a}, \quad \lim_{x \rightarrow 0} (1 + x)^{\frac{1}{x}}, \quad \lim_{x \rightarrow 0} \frac{a^x - 1}{x}$$

(ii) Differential coefficient. Its physical application- As rate measure, Geometric interpretation as slope of a curve. Differentiation from first principles of functions like  $x^n$ ,  $a^x$ ,  $\log x$ ,  $\sin x$ ,  $\cos x$  and  $\tan x$ . Differentiation of sum, product and quotient of functions.

(iii) Differentiation of Trigonometric and inverse Trigonometric functions. Differentiation of function of a function, Implicit functions, parametric functions, Logarithmic differentiation.

(iv) Applications of differentiation in finding errors, Tangent and normal of curves. Maxima and Minima of functions.

#### 2. INTEGRAL CALCULAS. (35%)

(i) Integration as inverse operation of differentiation. Integrals of standard functions. Integration by substitution, by parts and by partial fractions.

(ii) Evaluation of integrals in the form

$$\int \frac{1}{ax^2 + bx + c} dx, \quad \int \frac{px + q}{ax^2 + bx + c} dx, \quad \int \frac{1}{\sqrt{ax^2 + bx + c}} dx, \quad \int \frac{px + q}{\sqrt{ax^2 + bx + c}} dx$$

$$\int \sqrt{ax^2 + bx + c} dx, \quad \int (px + q)\sqrt{ax^2 + bx + c} dx$$

(iii) (a) Definite integrals.

(b) Properties of definite integrals and simple problems based upon them.

(c) Evaluation of integrals in the form  $\int_0^{\pi/2} \sin^m x \cos^n x dx$  using gamma function.

(iv) Applications of integration to finding area under a curve and axes, volume of solid of revolution of area about axes (simple problems). Mean value and R.M.S. value of a function.

(v) Numerical integrations. Approximate evaluation of definite integral by Trapezoidal rule and by Simpson's rule (without proof).

#### 3. PARTIAL DIFFERENTIATION. (10%)

(i) First order and second order partial derivatives of functions of two variables.

(ii) Euler's theorem for homogeneous functions, Simple problems on Total Differentiation.

#### 4. SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS. (15%)

Order and degree of a differential equation. Solving first order first degree differential equation – variable separable form, Homogeneous form and linear differential equation.

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**2.6 ENGINEERING DRAWING – II**

<b>L</b>	<b>T</b>	<b>P</b>
<b>2</b>	<b>-</b>	<b>6</b>

1. Detail and Assembly Drawing (2 sheets)
  - 1.1 Principle and utility of detail and assembly drawings
  - 1.2 Wooden joints i.e. corner mortice and tenon joint, Tee halving joint, Mitre faced corner joint, Tee bridle joint, Crossed wooden joint, Cogged joint, Dovetail joint, Through Mortice and Tenon joint, furniture drawing - freehand and with the help of drawing instruments.
2. Screw threads and threaded fasteners (8 sheets)
  - 2.1 Thread Terms and Nomenclature
    - 2.1.1 Types of threads-External and Internal threads, Right and Left hand threads (Actual and Conventional representation), single and multiple start threads.
    - 2.1.2 Different Forms of screw threads-V threads (B.S.W threads, B.A thread, American National and Metric thread), Square threads (square, Acme, Buttress and Knuckle thread)
  - 2.2 Nuts and Bolts
    - 2.2.1 Different views of hexagonal and square nuts and hexagonal headed bolt
    - 2.2.2 Assembly of Hexagonal headed bolt and Hexagonal nut with washer.
    - 2.2.3 Assembly of square headed bolt with hexagonal and with washer. and spring washer.
  - 2.3 Locking Devices
    - 2.3.1 Different types of locking devices-Lock nut, castle nut, split pin nut, locking plate, slotted nut
    - 2.3.2 Foundations bolts-Rag bolt, Lewis bolt, curved bolt and eye bolt.
  - 2.4 Drawing of various types of machine screw, set screw, studs and washers.
3. Keys and Cotters (3 sheets)
  - 3.1 Various types of keys and cotters and their practical application and preparation of drawing of various keys and cotters showing keys and cotters in position
  - 3.2 Various types of joints (3 sheets)
    - Spigot and socket joint
    - Gib and cotter joint
    - Knuckle joint
4. Rivets and Riveted Joints (4 sheets)
  - 4.1 Types of general purpose-rivets heads (4 Sheets)
  - 4.2 Caulking and fullering of riveted joints
  - 4.3 Types of riveted joints
    - (i) Lap joint-Single riveted, double riveted (chain and zig-zag type)
    - (ii) Single riveted, Single cover plate butt joint (chain type)
    - (iii) Single riveted, double cover plate butt joint (chain type)
    - (iv) Double riveted, double cover plate butt joint(chain and zig-zag type)
5. Couplings (2 sheets)
  - 5.1 Flange coupling (Protected and non-protected), muff coupling and half-lap muff coupling
6. Symbols and Conventions (2 sheets)
  - 6.1 Civil engineering sanitary fitting symbols
  - 6.2 Electrical fitting symbols for domestic interior installations
7. AUTO CAD (for practical and viva-voce only)
  - 7.1 Concept of AutoCAD, Tool bars in AutoCAD, coordinate system, snap, grid, and ortho mode
  - 7.2 Drawing commands – point, line, arc, circle, ellipse
  - 7.3 Editing commands – scale, erase, copy, stretch, lengthen and explode

**Note:** Minimum 20 drawing sheets will be prepared by the students.

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**ES 122 BASICS OF INFORMATION TECHNOLOGY**

<b>L</b>	<b>T</b>	<b>P</b>
<b>-</b>	<b>-</b>	<b>4</b>

**TOPICS TO BE EXPLAINED THROUGH DEMONSTRATION**

1. Information Technology – its concept and scope, applications of IT, ethics and future with information technology
2. Impact of computer and IT in society.-- Computer application in office, book publishing, data analysis, accounting, investment, inventory control, graphics, air and railway ticket reservation, robotics, military, banks, Insurance financial transactions and many more
3. Generations of computer, block diagram of a computer, CPU, memory, data – numeric data, alpha numeric data, processing of data.
4. Computers for information storage, information seeking, information processing and information transmission, computer organization, computer hardware and software; primary and secondary memory: RAM, ROM, PROM etc. Input devices; keyboard, mouse, scanner, etc ; output devices ; VDU and Printer(Impact and non-Impact printers), Plotter etc. Primary and Secondary Storage (Auxiliary Storage), Secondary storage; magnetic disks – tracks and sectors, optical disk (CD, CD-RW and DVD Memory)
5. Introduction to Operating Systems such as MS-DOS and Windows, difference between DOS and Windows
6. Basics of Networking – LAN, MAN,WAN

**LIST OF PRACTICALS**

1. Identify and list functions of various components and peripherals of given computer.
2. Installation of operating system viz. \* Windows XP, \*Windows 2007 etc.
3. Installing a computer system by giving connection and loading the system software and application software and various sources to install software
4. Exercises on entering text and data (Typing Practice)

## 5. Features of Windows as an operating system:

- a) Start , shutdown and restore
- b) Creating and operating on the icons
- c) Opening, closing and resizing the windows
- d) Using elementary job commands like – creating, saving, modifying, renaming, finding and deleting a file , creating and operating on a folder
- e) Introduction to all properties such as changing settings like, date, time, calculator, colour (back ground and fore ground)
- f) Using short cuts

## 6. Word Processing (MS Office/Open Office)

- a) File Management:  
Opening, creating and saving a document, locating files, copying contents in some different file(s)
- b) Editing a document:
  - Entering text, cut, copy, paste using toolbars
  - Use of spell check
  - PDF file and its conversion in different file formats (MS Word/Excel etc.)
  - Scanning, editing and printing of a document
- c) Formatting a document:
  - Using different fonts, changing font size and colour, changing the appearance through bold/ italic/ underlined, highlighting a text, changing case, using subscript and superscript, using different underline methods
  - Aligning of text in a document, justification of document, Inserting bullets and numbering
  - Formatting paragraph, inserting page breaks and column breaks, line spacing
  - Use of headers, footers, inserting footnote, end note, use of comments
  - Inserting date, time, special symbols, importing graphic images, drawing tools
- d) Tables and Borders:
  - Creating a table, formatting cells, use of different border styles, shading in tables, merging of cells, partition of cells, inserting and deleting a row in a table
  - How to change docx file to doc file
  - Print preview, zoom, page set up, printing options
  - Using Find, Replace options

## 7. Spread Sheet Processing (MS Office/Open Office)

- a) Starting Excel  
open worksheet, enter, edit data, formulae to calculate values, format data, create chart, printing chart, save worksheet, switching between different spread sheets
- b) Menu commands:  
Create, format charts, organize, manage data, solving problem by analyzing data, creating graphs
- c) Work books:
  - Managing workbooks (create, open, close, save, rename), working in work books
  - Editing a worksheet: copying, moving cells, pasting, inserting, deleting cells, rows, columns, find and replace text, numbers of cells, formatting worksheet
- d) Creating a chart:
  - Working with chart types, changing data in chart, formatting a chart, use chart to analyze data
  - Using a list to organize data, sorting and filtering data in list
- e) Formulas:  
Addition, subtraction, division, multiplication, percentage and auto sum

## 8. Power Point Presentation (MS Office/Open Office)

- a) Introduction to PowerPoint
  - How to start PowerPoint
  - Working environment: concept of toolbars, slide layout, templates etc.
  - Opening a new/existing presentation
  - Different views for viewing slides in a presentation: normal, slide sorter etc.
- b) Addition, deletion and saving of slides
- c) Insertion of multimedia elements
  - Adding text boxes, importing pictures, tables and charts etc.
- d) Formatting slides
  - Text formatting, changing slide layout, changing slide colour scheme
  - Changing background, Applying design template
- e) How to view the slide show?
  - Viewing the presentation using slide navigator, Slide transition
  - Animation effects etc.

## 9. Antivirus

- a) What is virus and its types
- b) Problems due to virus
- c) Installation and updation of antivirus (anyone out of Kaspersky, McAfee, Norton, Quickheal etc).
- d) How to scan and remove the virus

## 10. Internet and its Applications

- a) Log-in to internet, introduction to search engine, Browsing and down loading of information from internet
  - b) Creating e-Mail Account
    - Log in to e-mail account and Log out from e-mail account
  - c) Managing e-Mail
    - Creating a message
    - Sending, receiving and forwarding a message
    - Attaching a file
    - Deleting a message
-

**ES-120 \*APPLIED MECHANICS**

<b>L</b>	<b>T</b>	<b>P</b>
<b>4</b>	<b>2</b>	<b>2</b>

**1. Introduction (5%)**

Concept of mechanics and applied mechanics – Explanation of mechanics and applied Mechanics, its importance and necessity, giving suitable examples on bodies at rest and in motion, explanation of branches of this subject.

**2. Laws of Forces (15%)**

Force and its effects. Units and measurement of force. Characteristics of force vector representation. Bow's notation. Types of forces, action and reaction, tension & thrust. Force systems: Coplanar and space force systems. Coplanar, concurrent and non-concurrent forces. Free body diagrams. Resultant and components of forces, concept of equilibrium; parallelogram law of forces. Equilibrium of two forces, superposition and transmissibility of forces, Newton's third law, triangle law of forces, different cases of concurrent coplanar, two forces systems, extension of parallelogram law and triangle law to many forces acting at one point-polygon law of forces, method of resolution into orthogonal components for finding the resultant, graphical methods, special case of three concurrent, coplanar forces, Lami's theorem.

**3. Moments (15%)**

Concept of moment, Varignon's theorem – statement only. Principle of moments – application of moments to simple mechanism. Parallel forces, like and unlike parallel forces, calculation of their resultant, concept of couple, moving a force parallel to its line of action, general cases of coplanar force system, general conditions of equilibrium of bodies under coplanar parallel forces.

**4. Friction (10%)**

Concept of friction, laws of friction, limiting friction and coefficient of friction, sliding friction and rolling friction, inclined plane.

**5. Centre of Gravity and Centroid (15%)**

Concept of gravity, gravitational force, centroid and centre of gravity. Centroid for regular lamina and center of gravity for regular solids. Position of centre of gravity of compound bodies and centroid of composite area. CG of bodies and areas with portions removed.

**6. Moment of Inertia of Plane Areas (15%)**

Concept of Moment of Inertia and second moment of area and Radius of gyration, theorems of parallel and perpendicular axes, second moment of area of common geometrical sections: rectangle, triangle, circle (without derivations). Second moment of area for L, T and I sections. Section modulus without derivation.

**7. Laws of Motion (15%)**

Concept of momentum, Newton's laws of motion, their application, derivation of force equation from second law of motion, numerical problems on second law of motion, piles, lifts, bodies tied with string, Newton's third law of motion numerical problems, conservation of momentum, impulse and impulsive force (definition only).

**8. Simple Lifting Machines (10%)**

Concept of machine, mechanical advantage, velocity ratio and efficiency of a machine, their relationship, law of machine, simple machines (lever, wheel and axle, pulleys, jacks winch crabs only).

**LIST OF PRACTICALS**

1. Verification of the laws of polygon of forces.
2. To verify the forces in the different members of a jib crane.
3. To verify the reaction at the supports of a simply supported beam.
4. To find the mechanical advantage, velocity ratio and efficiency in the case of inclined planes
5. To find the mechanical advantage, velocity ratio and efficiency in the case of Screw Jack
6. To find the mechanical advantage, velocity ratio and efficiency in the case of worm and worm wheel
7. To find the mechanical advantage, velocity ratio and efficiency in the case of single winch Crab.
8. To find out centre of gravity of regular and irregular laminas.

**BS-214 \* APPLIED CHEMISTRY**

	<b>L</b>	<b>T</b>	<b>P</b>
<b>Pds/week</b>	<b>4</b>	<b>-</b>	<b>2</b>

**1. Structure of Atom (10%)**

Rutherford model of the structure of atom, Bohr's theory of H atom and equation deduced. Quantum numbers and their significance, De-Broglie equation and uncertainty principle. Electronic configuration of 1 to 30 elements, effect of temperature on conductivity of germanium and silicon.

**2. Periodic Properties of Elements (10%)**

Periodic law, periodic table, periodicity in properties like atomic radii and volume, ionic radii, ionization energy and electron affinity. Division of elements into s.p.d. and f block.

**3. Chemical Bonds (10%)**

Electrovalent, covalent and coordinate bond and their properties. Metallic bonding (electron cloud model) and properties (like texture, conductance, lusture, ductility and malleability). Orbital concept of covalence, hybridization (simple treatment).

**4. Fuel and their Classification (12%)**

Definition, characteristics, Classification, into solid, liquid and gaseous fuel, Petroleum and brief idea of its refining into various fraction and their characteristics and uses.

**5. Water (12%)**

Impurities in water, method of their removal, hardness of water, its types, causes and removal, Disadvantage of Hard water in boilers pH value and its determination by calorimetric method.

**6. Metals (12%)**

Cast iron and its properties, effect of sulphur, silicon and phosphorous as impurities in cast iron. Elementary knowledge of heat treatment of steels-hardening, tempering, annealing, normalizing and case hardening.

**7. Alloys (12%)**

Definition, classification and necessity for making alloys. Composition, properties and uses of following alloys: Brass, Bronze, Gun-metal and Duralumin. Effect of carbon, nickel, chromium, manganese on steel.

**8. Corrosion (12%)**

Its meaning, theory of corrosion, prevention of corrosion by various methods using metallic and non-metallic coatings.

**9. Plastics and Polymers (10%)**

Plastics-thermo-plastic and thermo setting. Introduction of Polythene, P.V.C., Nylon, synthetic rubber and phenol-formaldehyde resin. Their application in industry.

**LIST OF PRACTICALS**

1. To find the strength in grams per litre of the given solution of sodium hydroxide with the help of standard oxalic acid solution.
  2. Find the strength in grams per litre of given sodium hydroxide solution with the help of standard sodium-carbonate solution and intermediate solution of an acid.
  3. Determine the total alkalinity in ppm in the given sample of water using standard sulphuric acid.
  4. To find the amount of chloride ions present in water using silver nitrate solution (potassium chromate as indicator)
  5. Determine the type of alkalinity in ppm present in a given sample of H<sub>2</sub>O using standard sulphuric acid.
- 

**GENERAL WORKSHOP PRACTICE – II**

<b>L</b>	<b>T</b>	<b>P</b>
-	-	<b>8</b>

**1. Carpentry Shop-II**

1.1 Introduction to joints, their relative advantages and uses.

Job I Preparation of dovetail joint and glued joint.

Job II Preparation of mitre joint

Job III Preparation of a lengthening Joint

1.2 Demonstration of job showing use of rip saw, bow saw and tenon saw, method of sharpening various saws.

1.3 Demonstration of job on band saw and circular saw, chain and chisel, universal wood working machine, Saw re-sharpening machine, saw brazing unit.

1.4 Importance and need of polishing wooden items. Introduction to polishing materials.

Job IV Polishing on wooden items.

**2. Plumbing Shop**

2.1 Introduction to various types of threads (internal and external)-single start, multi-start, left hand and right hand threads.

2.2 Description and demonstration of various types of drills, taps and dies Selection of dies for threading, selection of drills, taps and reamers for tapping operations.

Job I Making internal and external threads on a job by tapping and dieing operations (manually)

**3. Welding Shop – II**

3.1 Introduction to gas welding, spot welding and seam welding and welding techniques. Adjustments of different types of flames in gas welding, demonstration and precautions about handling welding equipments.

Job I Practice in handling gas welding equipments (Low pressure and High pressure) and welding and tacking practice on simple jobs.

3.2 Common welding joints generally made by gas welding.

Job II Preparation of butt joint by gas welding.

Job III Exercise of preparing a job on spot/seam welding machine.

**4. Painting Shop - II**

4.1 Introduction to painting shop and its necessity. Different types of paints. Introduction of powder coating plant and spray painting with their uses.

Job I Preparation of surface before painting such as cleaning, sanding, applying putty, filling procedure and application of primer coat and painting steel item.

Job II Painting practice by brush on MS sheet

Job III Practice of dip painting

Job IV Practice of lettering: name plates / sign board

Job V Polishing and painting on wooden and metallic surfaces

4.2 Demonstration of powder coating

**5. Fitting Shop –II**

5.1 Introduction to various types of drilling machines, work & tool holding devices of drilling machines.

5.2 Care, maintenance & handling of various types of drilling machines. Precautions while performing drilling operation.

Job I Drilling practice on ferrous metal e.g. mild steel etc.

5.3 Precautions while drilling soft metals, e.g. copper, brass, aluminium etc.

Job II Drilling practice on soft metals such as aluminum, brass and copper

Job III Preparation of a job by filing on non-ferrous metal up to an accuracy of 0.2mm

## MECH. ENGG. / MECH. MAINT. ENGG. THIRD SEMESTER

## 2014 SCHEME

Code No.	Subject	Study Scheme Period/Week			Evaluation Scheme						Total Marks
		L	T	P	Internal Assessment		External Assessment Exam				
					Theory	Practical	Written Paper		Practical		
					Max Marks	Max. Marks	Max. Marks	Hrs.	Max. Marks	Hrs.	
ME-3.1	Material Science	3	-	2	50	50	100	3	100	3	300
ME-3.2	Thermal Engineering-I	3	2	2	50	50	100	3	100	3	300
ME-3.3	Basics of Electrical and Electronics Engineering	3	-	2	50	50	100	3	100	3	300
ME-3.4	Manufacturing Technology – I	3	-	-	50	-	100	3	-	-	150
ME-3.5	Machine Drawing-I	1	-	5	-	50	100	-	-	-	150
ME-3.6	Environmental Studies	4	-	-	50	-	100	3	-	-	150
ME-3.7	Workshop Practice – III	-	-	8	-	50	-	-	100	-	150
**	Student Centred Activities	-	-	2	-	-	-	-	-	-	-
	<b>Total</b>	<b>17</b>	<b>2</b>	<b>21</b>							<b>1500</b>

## 3.1 MATERIAL SCIENCE

L            T            P  
3            -            2

## 1. General (10%)

- 1.1 Introduction to engineering materials
- 1.2 Classification of materials
- 1.3 Thermal, Chemical, electrical, mechanical properties of various materials.
- 1.4 Selection criteria for use in industry

## 2. Structure of Metals and their Deformation (15%)

- 2.1 Metal Structure – Relation of metal structure to its properties
- 2.2 Arrangement of atoms in metals (Basic idea)
- 2.3 Crystalline structure of metals
- 2.4 Crystal Imperfections
- 2.5 Deformation of metal
- 2.6 Impact of cold and hot working on metal structure
- 2.7 Corrosion, its cause and prevention

## 3. Ferrous Materials (20%)

- 3.1 Classification of iron and steel
- 3.2 Sources of iron ore and its availability
- 3.3 Manufacture of pig iron, wrought iron, Cast iron and steel (Flow Diagrams only)
- 3.4 Types of Cast Iron: White, malleable, grey, mottled, modular and alloy and their usage
- 3.5 Concept of Powder Metallurgy.
- 3.6 Steels and alloy steel
  - i) Classification of steels
    - ii) Different manufacturing methods of steel – open hearth, Bessemer, electric arc.
    - iii) Availability, Properties and usage of steels
    - iv) Specification as per BIS and equivalent standards.
    - v) Effect of various alloying element like Cr, Ni, Co, V, W, Mo, Si, Mn, S on mechanical properties of steel.
    - vi) Use of alloy steels (high speed steel, stainless steel, spring steel, silicon steel)

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#### 4. Non Ferrous Materials

(15%)

- 4.1 Important ores and properties of Aluminium, Copper, Zinc, Tin, Lead
- 4.2 Properties and uses of Al alloys, Copper alloys, Bearing metals, solders

#### 5. Engineering Plastics and Fibers (10%)

- 5.1 Important sources of plastics
- 5.2 Classification – thermo and thermo set plastic.
- 5.3 Various Trade names of engineering plastics
- 5.4 Plastic Coating
- 5.5 Fibers and their classification: Inorganic and Organic Fibers
- 5.6 Usage of fibers

#### 6. Insulating Materials

(10%)

- 6.1 Various heat insulating material and their usage like asbestos, glass wool, thermocole, cork, puf, china clay.
- 6.2 Various electrical insulating material and their use like China clay, leather, bakelite, Ebonite, glass wool, rubber, felt
- 6.3 Ceramics-Classification, properties, applications

#### 7. Testing of Metals and Alloys

(5%)

- 7.1 Identification test: appearance, sound, spark, weight, magnetic, band microstructure, filing.

#### 8. Fundamentals of Heat Treatment

(15%)

- 8.1 Purpose of heat treatment
- 8.2 Theory of solid solution
- 8.3 Iron-Carbon Diagram
- 8.4 TTT Curve in steels and its importance
- 8.5 Basic idea about martensitic transformation
- 8.6 Various heat treatment processes-hardening, tempering, annealing, normalizing, case hardening (elementary idea)
- 8.7 Types of heat treatment furnaces
- 8.8 Concepts of Vacuum Heat Treatment

### LIST OF PRACTICAL (MATERIAL SCIENCE)

1. Classification of about 25 specimens of materials/parts into
  - i) Metals and non metals
  - ii) Metals and alloys
  - iii) Ferrous and non ferrous metals
  - iv) Ferrous and non ferrous alloys
2. Given a set of specimen of metals and alloys (copper, brass, aluminium, cast iron, HSS, Gun metal); identify and indicate the various properties possessed by them
  - i) Study of heat treatment furnace
  - ii) Study of a thermocouple/pyrometer
3. Study of a metallurgical microscope and a diamond-polishing machine
4. To prepare specimens of following materials for microscopic examination and to examine the microstructure of the specimens of following materials:
  - i) Brass
  - ii) Copper
  - iii) Grey CI
  - iv) Malleable CI
  - v) Low carbon steel
  - vi) High carbon steel
  - vii) HSS
5. To anneal a given specimen and find out difference in hardness as a result of annealing
6. To normalize a given specimen and to find out the difference in hardness as a result of normalizing
7. To temper a specimen and to find out the difference in hardness and tensile strength due to tempering

### 3.2 THERMAL ENGINEERING-I

L	T	P
3	2	2

#### 1. Basic Concepts and Gas laws (10%)

- i) Gas laws : Boyle's Law, Charle's Law
- ii) Characteristics equation, Gas constant, Universal Gas constant.
- iii) Thermodynamics, system (open and closed), surroundings, property, process, cycle quasi-static process. Heat, specific heat, thermodynamic concept of work.
- iv) Constant Volume, constant pressure Isothermal, adiabatic and polytropic processes, Throttling and free Expansion, work done under these processes.

#### 2. Laws of Thermodynamics

(15%)

- i) Explanation of the Zeroth law of Thermodynamics
- ii) First law of thermodynamics for a closed system undergoing a cycle; for a process.
- iii) Concept of Internal energy.
- iv) First Law of Thermodynamics for an open system – steady flow energy equation.
- v) Clausius and Kelvin Planck statements of second law of thermodynamics.
- vi) Concept of Entropy.
- vii) Entropy change during various processes.



**3. Formation of Steam and its Properties (20%)**

- i) Steam formation at constant pressure
- ii) Wet steam, dry steam and saturated steam.
- iii) Dryness fraction
- iv) Sensible heat, latent heat, total heat, internal energy, specific volume.
- v) Expansion of vapors according to various thermodynamic processes.
- vi) Use of steam table
- vii) Entropy of water, wet, dry and superheated steam
- viii) Use of temperature Entropy charts.

**4. Steam Generator (15%)**

- i) Uses of steam
- ii) Classification of boilers.
- iii) Comparison of fire tube and water tube boilers
- iv) Constructional features of Lancashire, Cochran, Babcock and Wilcox boilers.
- v) Boiler mountings
- vi) Boiler accessories – economizer, super heater.
- vii) Introduction to fuel for boilers.
- viii) Performance of boilers – equivalent evaporation, Boiler efficiency.

**5. Steam Prime Movers (10%)**

- i) Rankine cycle, modified Rankine cycle, efficiency Rankine cycle, Indicator diagram. Effect of pressure and temperature on Rankine cycle, Reheat cycle, Regenerative cycle.
- ii) Flow through nozzles, calculation of exit velocities and conditions for maximum discharge.
- iii) Principles, construction and working of Impulse and Reaction Turbines. Pressure and velocity compounding its advantages and disadvantages. Bleeding of steam and its effect on steam turbine efficiency, limits on number of bleeding (No numerical)

**6. Steam Condensers (10%)**

- i) Function, working principle, classification and description of surface condensers.
- ii) Cooling Towers and cooling ponds.
- iii) Sources of air in condensers.
- iv) Simple calculations for cooling water in condensers.

**7. Steam Power Plant (5 %)**

General description with a layout diagram showing details of all units.

**8. Heat Transfer (15%)**

- i) Thermal conduction, basic equation, conduction through a thick plain wall, composite wall and pipe lagging.
- ii) Thermal convection, natural and forced convection, basic equation.
- iii) Thermal radiation, reflection absorption, and transmission. Concept of black, white and opaque bodies, Stefan Boltzman's Law (simple problems on Heat Transfer)

**LIST OF PRACTICALS (THERMAL ENGINEERING-I)**

- 1. Study of pressure gauge and water level indicator on a boiler.
- 2. Study of stop valve, dead weight safety valve and fusible plug.
- 3. Study of stop lever and spring loaded safety valve, high steam and low water alarm.
- 4. Study of blow off cock, feed check valve and feed – water pump.
- 5. Study of Lancashire Boiler.
- 6. Study of Cochran Boiler
- 7. Study of Babcock and Wilcox Boiler
- 8. Study of super heating and throttling calorimeter.
- i) Study of economizer and super heater
- ii) Study of impulse and reaction turbines through models.
- iii) Visit to a thermal power plant

**3.3 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING**

L	T	P
3	-	2

**1. Basic Quantities of Electricity (8%)**

Definition of voltage, current, power and energy with their units, name of instruments used for measuring above quantities. Connection of the instruments in an electric circuit

**2. Application and Advantages of Electricity (5%)**

Difference between AC and DC, various applications of electricity, advantages of electrical energy over other types of energy

**3. Electromagnetic Induction (7%)**

Definition, construction & principle of working of Transformer. Production of e.m.f., idea of transformer and it's numerical.

**4. Various Types of Power Plants (10%)**

Elementary block diagrams of thermal, hydro and nuclear power stations. Brief explanation of the principle of power generation in above power stations

**5. Elements of Transmission Line (10%)**

Pictorial diagram of 3-phase transmission and distribution system showing transformers, supports, conductors, insulators and earth wire etc. Brief function of accessories of transmission lines

**6. Distribution system (15%)**

Distinction between high and low voltage distribution system, Identification of 3-phase wire, neutral wires and earth wire on a voltage distribution system. Identification of voltages between phases and between one phase and neutral. Distinction between 3-phase and 1-phase supply.

**7. Supply from Poles to Distribution System (10%)**

Arrangement of supply system from pole to the distribution board. Function of service line, energy meter, main switch, distribution board

**8. Domestic Installation (15%)**

Distinction between light and fan circuits and 1-phase power circuit, sub-circuits. Various accessories and parts of Installation. Identification of wiring systems. Common safety measures on earthing.

**9. Electric Motor (6%)**

Definition and various applications of single phase and 3-phase motors. Connection and starting of 3-phase motors by star-Delta starter. Conversion of HP units watts and KW.

**10. Electrical Safety (7%)**

Electrical shock and precautions against shock, treatment of electric shock, concept of fuses and their classification, selection and application, concept of earthing and various types of earthing, applications of MCBs and ELCBs

**11. Basic Electronics (7%)**

Basic idea of semiconductors – P and N type; diodes, zener diodes and their applications, transistor – PNP and NPN, symbols, identification of terminals of transistor, current flowing in a transistor, its characteristics and uses. Characteristics and applications of a thyristor. Basic idea of MOSFET & IGBT. Concept of PLC & Sensors.

**LIST OF PRACTICALS:-**

1. Study of shock treatment & its precautions.
  2. Use of Megger
  3. Charging of Battery
  4. Transformer-to measure input and output voltage and currents of a loaded transformer
  5. Trouble shooting in domestic wiring system
  6. Connection of a one-phase induction motor to supply and reversing of its direction of rotation
  7. Connection of and reading of an electric energy meter
  8. Study of a distribution Board for domestic installation
  9. Draw V-I characteristics of P-N junction diode
  10. Draw input and output characters of a transistor
  11. Draw reverse break down characteristics of a zener diode
- 

**3.4 MANUFACTURING TECHNOLOGY-1**

L	T	P
3	-	-

**1. Cutting Tools and Cutting Materials (10%)**

**1.1** Cutting Tools - Various types of single point cutting tools and their uses, Single point cutting tool geometry, tool signature and its effect, Heat produced during cutting and its effect, Cutting speed, feed and depth of cut and their effect

**1.2** Cutting Tool Materials - Properties of cutting tool material, Study of various cutting tool materials viz. High-speed steel, tungsten carbide, cobalt steel cemented carbides, stellite, ceramics and diamond.

**2. Lathe (20%)**

**2.1** Working principle of turning

**2.2** Function of various parts and accessories of a lathe

**2.3** Classification and specification of various types of lathe

**2.4** Work holding devices

**2.5** Lathe tools and operations :- Plain and step turning, facing, parting off, taper turning, eccentric turning, drilling, reaming, boring, threading and knurling, form turning, spinning.

**2.6** Cutting parameters – Speed, feed and depth of cut for various materials and for various operations, machining time.

**2.7** Speed ratio, preferred numbers of speed selection.

**2.8** Introduction to capstan and turret lathe

**3. Welding (20%)**

**3.1** Welding Process

**3.2** Principle of welding, Classification of welding processes, Advantages and limitations of welding, Industrial applications of welding, Welding positions and techniques, symbols.

**3.3** Gas Welding

Principle of operation, Types of gas welding flames and their applications, Gas welding equipment - Gas welding torch, Oxy acetylene cutting torch, Blow pipe, Pressure regulators, Filler rods and fluxes

**3.4** Arc Welding

Principle of operation, Arc welding machines and equipment, A.C. and D.C. arc welding, Effect of polarity, current regulation and voltage regulation

### 3.5 Other Welding Processes

- Resistance welding, introduction to spot, seam and projection welding
- Modern welding methods – TIG, MIG, ultrasonic welding, laser welding, robotic welding

#### 3.5 Welding Defects

Types of welding defects, methods of controlling welding defects, inspection of welding defects

### 4. Pattern Making (10%)

Types of pattern, Pattern material, Pattern allowances, Pattern codes as per B.I.S., Introduction to cores, core boxes and core materials, Core making procedure, Core prints, positioning of cores

### 5. Moulding and Casting (25%)

#### 5.1 Moulding Sand

Properties of moulding sand, their impact and control of properties. Various types of moulding sand.

#### 5.2 Mould Making

Types of moulds, molding boxes, hand tools used for mould making, molding processes, molding machines: squeeze machine, jolt squeeze machine and sand slinger. 5.3 Casting Processes

Charging a furnace, melting and pouring both ferrous and non ferrous metals, cleaning of castings, Principle, working and applications of Die casting, investment Casting

#### 5.4 Gating and Riser System

Elements of gating system, Pouring basin, sprue, runner, gates, Types of risers, location of risers, Directional solidification

#### 5.5 Melting Furnaces

Construction and working of Pit furnace, Cupola furnace, Crucible furnace – tilting type, Electric furnace

#### 5.6 Casting Defects

Different types of casting defects, Testing of defects through magnetic particle inspection.

### 6. Metal Forming Processes (15%)

6.1 Press Working - Types of presses, type of dies, selection of press die, die material. Press Operations-Shearing, piercing, trimming, punching, notching, shaving, gearing, embossing, stamping

6.2 Forging - Open die forging, closed die forging, Press forging, upset forging, swaging, up setters, roll forging, Cold and hot forging

6.3 Rolling - Elementary theory of rolling, Types of rolling mills, Thread rolling, roll passes, Rolling defects and remedies

6.4 Extrusion and Drawing - Type of extrusion- Hot and Cold, Direct and indirect. Pipe drawing, tube drawing, wire drawing

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### 3.6 MACHINE DRAWING-I

L	T	P
1	-	5

1. Lecture on Limits, Fits, Tolerances and surface finish (15%)

2. Lecture on Bushed Bearings.

Sheet # 1, 2 & 3 Simple Bush bearing, Ball Bearing, Plummer Block, Foot Step Bearing\* (25%)

3. Lecture on Universal Coupling, Wall Bracket.

Sheet# 4 & 5 on Universal Coupling\*, Wall Bracket. (15%)

4. Lecture on Lathe Parts.

Sheet 6 & 7 on Tool Post\*, Tail Stock\* (15%)

5. Lecture on Bench Vice and Screw Jack.

Sheet # 8 & 9 Bench Vice\*, Screw Jack\* (15%)

6. Lecture on I. C. Engine Parts.

Sheet # 10 Piston\*. Connecting Rod, Crank Shaft in the sketchbook.

(15%)

7. Reading and interpreting of Drawing

\* means at least 4 drawings should be made from the actual parts made available to the student and the student should sketch the views in the sketchbook along with dimensions. The final scaled drawing is to be made from the data recorded in the sketchbook. Four turns are allotted for this.

### Third Angle Projection to be followed.

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#### 3.6 ENVIRONMENTAL STUDIES

L	T	P
4	-	-

##### 1. The Multidisciplinary nature of environmental studies

(5%)

Definition, scope and importance, Need for public awareness.

##### 2. Natural Resources

(15%)

###### Renewable and non renewable resources:

a) Natural resources and associated problems

i) Forest resources: Use and over-exploitation, deforestation, case studies, Timber extraction, mining, dams and their effects on forests and tribal people.

ii) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dam's benefits and problems.

iii) Mineral Resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

iv) Food Resources: World food problems, changes caused by agriculture and over grazing, effects of modern agriculture, fertilizers- pesticides problems, water logging, salinity, case studies.

v) Energy Resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources, casestudies

vi) Land Resources: Land as a resource, land degradation, man induces landslides, soil erosion, and desertification.

b) Role of individual in conservation of natural resources.

c) Equitable use of resources for sustainable life styles.

##### 3. Eco Systems

(15%)

a) Concept of an eco system

b) Structure and function of an eco system.

c) Producers, consumers, decomposers.

d) Energy flow in the eco systems.

e) Ecological succession.

f) Food chains, food webs and ecological pyramids.

g) Introduction, types, characteristic features, structure and function of the following eco systems:

h) Forest ecosystem

i) Grass land ecosystem

j) Desert ecosystem.

k) Aquatic eco systems (ponds, streams, lakes, rivers, oceans, estuaries)

##### 4. Biodiversity and it's Conservation

(15%)

a) Introduction-Definition: genetics, species and ecosystem diversity.

b) Biogeographically classification of India.

c) Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values

d) Biodiversity at global, national and local level.

e) India as a mega diversity nation.

f) Hot-spots of biodiversity.

g) Threats to biodiversity: habitats loss, poaching of wild life, man wildlife conflicts.

h) Endangered and endemic spaces of India.

i) Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

##### 5. Environmental Pollution

(15%)

Definition Causes, effects and control measures of:

a) Air pollution

b) Water pollution

c) Soil pollution

d) Marine pollution

e) Noise pollution

f) Thermal pollution

g) Nuclear hazards

Solid waste Management: Causes, effects and control measures of urban and industrial wastes.

Role of an individual in prevention of pollution Pollution case studies Disaster management: Floods, earth quake, cyclone and land slides

##### 6. Social issues and the Environment

(15%)

a) Form unsustainable to sustainable development

b) Urban problems related to energy

c) Water conservation, rain water harvesting, water shed management

d) Resettlement and rehabilitation of people; its problems and concerns, case studies

e) Environmental ethics: issues and possible solutions

f) Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies.

g) Wasteland reclamation

h) Consumerism and waste products

- Environment protection Act

- Air (prevention and control of pollution) Act
- Water (prevention and control of pollution) Act
- Wildlife protection act
- Forest conservation act
- Issues involved in enforcement of environmental legislations
- Public awareness

**Unit 7: Human population and the environment (10%)**

- Population growth and variation among nations
- Population explosion- family welfare program
- Environment and human health
- Human rights
- Value education
- HIV / AIDS
- Women and child welfare
- Role of information technology in environment and human health
- Case studies

**Unit 8: Field work (10%)**

Visit to a local area to document environment assets river / forest / grassland / hill/ mountain. Visit to a local polluted site-urban/rural/industrial/agricultural. Study of common plants, insects, birds. Study of simple ecosystems-pond, river, hill slopes, etc (field work equal to 5 lecture works)

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3.6 WORKSHOP PRACTICE - III

L	T	P
-	-	8

**LIST OF PRACTICALS**

General introduction to tools, equipments & machinery used in welding, pattern making, foundry, fitting and turning shop along with safety precautions.

**Welding Shop**

- Job 1. Preparing gas welding joint in vertical position joining M.S. Plates
- Job 2. Exercise on gas cutting of mild steel plate with oxy-acetylene gas torch.
- Job 3. Exercise on preparation of T Joint by arc welding.
- Job 4. A visit to a welding shop for detailed demonstration on MIG and TIG welding.

**Pattern making**

- Job 1. Preparation of solid/single piece pattern.
- Job 2. Preparation of two piece/split pattern
- Job 3. Preparation of a pattern on wooden lathe
- Job 4. Preparation of a self cored pattern and core box

**Foundry Shop**

- Job 1. Preparation of mould with solid pattern on floor.
- Job 2. Preparation of floor mould of split pattern in cope and drag of moulding box.
- Job 3. Moulding and casting of a solid pattern of aluminum.
- Job 4. A visit to foundry shop to have first hand knowledge of melting, pouring and casting.

**Fitting Shop**

- Job 1&2. Exercise involving Male & Female parts.
- Job 3. Preparation of simple die

**Turning Shop**

- Job 1. Exercise on preparation of single point cutting tool.
- Job 2. Exercise involving facing & plain turning.
- Job 3. Exercise involving step turning.



**MECH. / MECH.MAINT. ENGG.  
IV SEM**

Code No.	Subject	Study Scheme Period/Week			Evaluation Scheme						Total Marks
		L	T	P	Internal Assessment		External Assessment Exam				
					Theor y	Practi cal	Written Paper		Practical		
					Max Marks	Max. Marks	Max. Marks	Hrs.	Max. Marks	Hrs.	
ME-4.1	Strength of Materials	4	-	2	50	50	100	3	100	3	300
ME-4.2	Fluid Mechanics & Machines	4	-	2	50	50	100	3	100	3	300
ME-4.3	Thermal Engineering -II	4	-	2	50	50	100	3	100	3	300
ME-4.4	Machine Drawing – II	1	-	7	-	50	100	3	-	-	150
ME-4.5	Manufacturing Technology – II	4	-	-	50	-	100	3	-	-	150
ME-4.6	Workshop Practice – IV	-	-	8	-	50	-	-	100	3	150
**	Student Centered activities	-	-	2	-	-	-	-	-	-	-
	<b>TOTAL</b>	<b>17</b>	<b>-</b>	<b>23</b>	<b>200</b>	<b>250</b>	<b>500</b>	<b>-</b>	<b>400</b>	<b>-</b>	<b>1350</b>

**ME-4.1 STRENGTH OF MATERIALS**

**L T P**

**1 - 2**

**1. Stresses and Strains (25%)**

- 1.1 Concept of load, stresses and strain
- 1.2 Tensile, compressive and shear stresses and strains
- 1.3 Concept of Elasticity, Elastic limit and limit of proportionality.
  - 1.3.1 Hook's Law
  - 1.3.2 Young Modulus of elasticity
  - 1.3.3 Nominal stress
  - 1.3.4 Yield point, plastic stage
  - 1.3.5 Strain hardening
  - 1.3.6 Ultimate strength and breaking stress
  - 1.3.7 Percentage elongation
  - 1.3.8 Proof stress and working stress
  - 1.3.9 Factor of safety
  - 1.3.10 Lateral strain, Poisson's ratio
  - 1.3.11 Volumetric strain
  - 1.3.12 Shear modulus
  - 1.3.13 Strain energy due to direct stresses
  - 1.3.14 Proof resilience and modulus of resilience
  - 1.3.15 Stresses due to gradual, sudden and falling load
  - 1.3.16 Longitudinal and circumferential stresses in seamless thin walled cylindrical shells (derivation of these formulae not required)

**2. Beams and Bending Stress (35%)**

- 2.1 Bending and shearing force
  - 2.1.1 Concept of beam, form of loading
  - 2.1.2 Concept of end supports-Roller, hinged and fixed
  - 2.1.3 Concept of bending moment and shearing force
  - 2.1.4 B.M. and S.F. Diagram for cantilever and simply supported beams with and without overhang subjected to concentrated and U.D.L.
- 2.2 Bending stresses
  - 2.2.1 Concept of Bending stresses
  - 2.2.2 Theory of simple bending
  - 2.2.3 Use of the equation  $\sigma/y=M/I=E/R$
  - 2.2.4 Concept of moment of resistance
  - 2.2.5 Bending stress diagram

- 2.2.6 Calculation of maximum bending stress in beams of rectangular, circular, I and T section.
- 2.2.7 Permissible bending stress section modulus for rectangular, circular and symmetrical I section.
- 2.2.8 Comparison between I, rectangular and circular section with regard to their strength
- 2.3 Slope and deflection
  - 2.3.1 Simple cases of slope and deflection in simply supported beam with UDL on whole of the length and a point load at the centre
  - 2.3.2 Cantilever with UDL on whole of the length and a point load at the end (without derivation)
  - 2.3.3 Simple problems
- 2.4 **Laminated** Spring (Semi elliptical type only)
  - 2.4.1 Determination of number of plates
  - 2.4.2 Maximum bending stress and deflection
- 2.5 Combined direct and bending stresses. Simple cases of short columns of uniform section subject to eccentric loading with stress diagram
  
- 3. Columns (15%)**
  - 3.1 Concept of column, modes of failure
  - 3.2 Types of columns
  - 3.3 Buckling load, crushing load
  - 3.4 Slenderness ratio
  - 3.5 Factors effecting strength of a column
  - 3.6 End restraints
  - 3.7 Effective length
  - 3.8 Strength of column by Euler Formula without derivation
  - 3.9 Rankin- Gourdan formula (without derivation)
- 4. Torsion (15%)**
  - 4.1 Concept of torsion-difference between torque and torsion
  - 4.2 Derivation and use of torque equation  $T/J = l/R = G\theta/L$  for circular shaft
  - 4.3 Shear stress diagram for solid and hollow circular shaft
  - 4.4 Comparison between solid and hollow shaft with regard to their strength and weight.
  - 4.5 Power transmitted by shaft
  - 4.6 Concept of mean and maximum torque
- 5. Helical Springs (10%)**
  - 5.1 Closed coil helical springs subjected to axial load
  - 5.2 Stress deformation
  - 5.3 Stiffness and angle of twist and strain energy
  - 5.4 Falling load on springs

#### **LIST OF PRACTICALS**

1. Tensile test on bars of Mild steel and Aluminium.
  2. Shear test on specimen of two different metals.
  3. Bending tests on a steel bar or a wooden beam.
  4. Impact test on metals
    - (a) Izod test
    - (b) Charpy test
  5. Torsion test on specimens of different metals for determining the angle of twist for a given torque.
  6. To determine the stiffness of a helical spring and to plot a graph between load and extension.
  7. Hardness test on metal and finding the Brinell and Rockwell hardness.
- 

#### **ME-4.2 FLUID MECHANICS AND FLUID MECHINES**

<b>L</b>	<b>T</b>	<b>P</b>
<b>4</b>	<b>-</b>	<b>2</b>

- 1. Introduction (5%)**
  - 1.1 Concept of fluid, fluid mechanics and hydraulics.
  - 1.2 Properties of fluid (viscosity, specific weight, specific volume, specific gravity) with their units.
  - 1.3 Concept of capillarity
- 2. Static Pressure (5%)**
  - 2.1 Pascal's law
  - 2.2 Concept of static pressure, intensity of pressure and pressure head
  - 2.3 Total pressure on a plane surface and centre of pressure
- 3. Measurement of Pressure (10%)**
  - 3.1 Concept of atmospheric pressure, gauge pressure, absolute pressure, vacuum and differential pressure.
  - 3.2 Pressure measurement by: Piezometer tube, simple manometer, differential manometer, bourdon pressure gauge



#### 4. Flow of Liquids (15%)

- 4.1 Types of flow – Laminar and turbulent, steady and unsteady, uniform and non-uniform.
- 4.2 Concept of Reynolds's number
- 4.3 Rate of discharge
- 4.4 Equation of continuity
- 4.5 Energy of fluid – datum, pressure, velocity head and total head.
- 4.6 Bernoulli's theorem (without proof) and its applications.
- 4.7 Discharge measurement by venturimeter and orifice meter.
- 4.8 Pitot tube.

#### 5. Flow through Orifices (10%)

- 5.1 Types of orifices
- 5.2 Coefficient of orifices ( $C_c$ ,  $C_v$ ,  $C_d$ )
- 5.3 Discharge through a small orifices
- 5.4 Discharge through a large rectangular orifices under a submerged, partially submerged and free-conditions.
- 5.5 Time of emptying a tank of uniform area through an orifice at the bottom.

#### 6. Flow through Pipes (15%)

- 6.1 Concept of flow through pipes
- 6.2 Loss of energy due to friction
- 6.3 Factors influencing the loss due to friction
- 6.4 Darcy's equation for loss of energy and Chezy's equation (without proof)
- 6.5 Loss of head due to sudden enlargement, contraction, obstruction and bend (without proof)
- 6.6 Hydraulic gradient line and total energy line.
- 6.7 Pipes in series, parallel and branch pipes.
- 6.8 Application of flow through pipes.
- 6.9 Flow through siphon pipe.
- 6.10 Concept of water hammer.

#### 7. Hydraulic Turbines (15%)

- 7.1 Concept of a turbine
- 7.2 Types of turbines-Impulse and reaction type (concept only)
- 7.3 Construction and working of Pelton wheel, Francis turbines and Kaplan turbine.

#### 8. Pumps (15%)

- 8.1 Concept of hydraulic pump
- 8.2 Single acting reciprocating pump-construction, operation and application
- 8.3 Vane, screw and gear pumps-construction and working
- 8.4 Construction, working and operation of single stage centrifugal pump.
- 8.5 Work done, efficiencies and specifications of a centrifugal pump.
- 8.6 Power requirements of reciprocating pump and single stage centrifugal pump.
- 8.7 Common defects in the pumps and remedial measures.

#### 9. Hydraulic Devices (10%)

Working Principles, description and applications of:

- 9.1 Hydraulic accumulator
- 9.2 Intensifier
- 9.3 Hydraulic jack
- 9.4 Hydraulic press
- 9.5 Hydraulic ram

#### Note:

- \* -An expert may be invited from the industry to deliver the lecture.
- \*\* -An industrial visit may be arranged to explain and show the relevant things.

#### LIST OF PRACTICALS

1. Measure the pressure head of water in a pipe line by:
  - 1.1 Piezometer tube
  - 1.2 U-tube
  - 1.3 Bourden Gauge
2. To verify Bernoulli's theorem
3. To find the value of the coefficient of discharge for a venturimeter.
4. To find  $C_c$ ,  $C_v$  and  $C_d$  for small circular orifice.
5. To find  $C_c$ ,  $C_v$  and  $C_d$  for small triangular orifice
6. To find  $C_c$ ,  $C_v$  and  $C_d$  for small rectangular orifice
7. To determine the coefficient of friction (Darcy's 'f') for commercial pipes.
8. To dismantle a single stage centrifugal pump with a view to study its constructional details.
9. To study a single-stage, centrifugal pump with a view to acquaint the students with common troubles and their remedial measures.
10. To plot the following characteristics curves for a single stage centrifugal pump running at a constant speed.
  - 10.1 Discharge v/s Head
  - 10.2 Discharge v/s Horse Power
  - 10.3 Discharge v/s efficiency
11. To study the hydraulic circuit of any available machines.
12. To study the working models of

- 12.1 Pelton wheel
  - 12.2 Francis turbine
  - 13. To determine maximum head developed by a centrifugal pump
  - 14. Operation and maintenance of centrifugal pump.
- 

**ME-4.3 THERMAL ENGINEERING-II**

L	T	P
4	-	2

**1. Air cycles (10%)**

Thermodynamic cycles, concept of reversibility of cycle, thermal efficiency and air standard efficiencies, Carnot cycle – efficiency and its implications Otto, Diesel and dual combustion cycles – calculation of air standard efficiencies. Effect of compression ratio.

**2. Principles of I.C. Engines: (10%)**

Identification, location, functions and material of main parts of IC engine, concept of terms like bore, stroke, dead centers, crank-throw, piston, displacement, mean piston speed, compression ratio, clearance volume. Working of two stroke and four stroke petrol and diesel engines- single cylinder and multi cylinder engines, valve timing diagrams, classifications and application of I.C. Engines. Introduction to Rotary Wankle engine.

**3. Fuel System: (15%)**

Carburetion: Concept of carburetion, requirements of air fuel mixtures at various load conditions, simple carburetor and its limitations, modifications required in a simple carburetors to overcome the limitations (choke, idling devices, compensating jet, air bleed, MPFI system, CDRI, accelerating pump, principle and methods of fuel injection in diesel engines, control of fuel supply and types of nozzles. Working of a fuel injection pump. Fuel filters and mechanical fuel lift pump.

**4. Ignition Systems: (10%)**

Importance of Ignition timing and ignition advance, battery ignition and Magneto ignition, Modern ignition system.

**5. Cooling of I.C. Engines: (10%)**

Necessity of cooling, cooling systems, functions of thermostat, anti-freezing mixtures.

**6. Lubrication of IC Engines (10 %)**

Necessity of Lubrication, types and properties of lubricants (excluding testing of properties) Lubrication systems of IC Engines, gear type oil pump, oil filters, crank case ventilation, sludge formation.

**7. IC Engine (10 %)**

Calculation of IHP, BHP and efficiencies –Mechanical, thermal, overall, and relative; Morse test ,heat balance charts, Concept of pollutants in SI and CI engines, pollution control, norms for two and four wheelers – BIS – I, II, III, IV and Euro – V. Methods of reducing pollution in IC engines, alternative fuels like CNG and LPG.

**8. Air Compressors (15 %)**

Uses of compressor air, classification of air compressor, working principle of single and two stage reciprocating compressor, intercooling and aftercooling, Calculation of Horse power required to drive a compressor, Introduction to Rotary compressor, working of root-blower, vane type and centrifugal type compressor. Difference between fans blowers and compressor.

**9. Gas Turbines (10%)**

Introduction to gas turbines, working principles of constant volume and constant pressure type gas turbines. Open cycle and closed cycle gas turbines. Applications of gas turbines.

**LIST OF PRACTICALS**

1. Study of various parts of IC Engines.
  2. Draw the valve timing diagram of a diesel engine-single cylinder.
  3. Study the working of a carburetor used in scooter/motor cycle. Study of MPFI.
  4. Study a fuel injection pump, injector by dismantling it.
  5. Study a distributor of a four – cylinder petrol engine.
  6. Locate and draw the cooling circuit of multi-cylinder engine and study the construction of the radiator and locate and draw the lubricating circuit of a single cylinder diesel engine.
  7. To find out IHP, BHP and specific fuel consumption, specific fuel consumption and mechanical efficiency.
  8. Study the construction and working of a reciprocating air compressor.
  9. Study of following Automotive Parts, Front axle and Rear axle.
  10. Study of following Automotive systems
    - 10.1 Elements of Transmission systems- Differential, Gear Box, Clutch
    - 10.2 Braking System
  11. To study a gas turbine plant by local visit
-

#### ME-4.4 MACHINE DRAWING II

L	T	P
1	-	7

**NOTE:** -Weightage of each topic for external examination is given in the brackets. Third angle projection should be followed.

1. Lecture on Steam Stop Valve, Blow off Cock, Spring Loaded safety Valve Sheet # 1,2 & 3. (20%)
  2. Lecture on Cams and Followers: Sheet # 4, 5, 6 (Uniform motion, simple harmonic motion) (20%)
  3. Lecture on Jigs and Fixtures: Sheet # 7 Drill Jig, a typical fixture (20%)
  4. Lecture on different types of gears. Sheet # 8 Spur Gear with actual representation of profile, #9 Conventional representations of bevel gear, worm and worm wheel. (20%)
  5. Lecture on Clutch. Sheet #10 Assembly of single plate clutch. (20%)
- 

#### ME-4.5 MANUFACTURING TECHNOLOGY-II

L	T	P
4	-	-

- 1. Drilling (15%)**
    - 1.1 Principle of drilling.
    - 1.2 Classification of drilling machines and their description.
    - 1.3 Various operation performed on drilling machine – drilling, spot facing, reaming, boring, counter boring, counter sinking, hole milling, tapping.
    - 1.4 Speeds and feeds during drilling, impact of these parameters on drilling, machining time.
    - 1.5 Types of drills and their features, nomenclature of a drill
    - 1.6 Drill holding devices.
  - 2. Boring (10%)**
    - 2.1 Principle of boring
    - 2.2 Classification of boring machines and their brief description.
    - 2.3 Boring bars and boring heads.
  - 3. Shaping, Planing and Slotting (15%)**
    - 3.1 Working principle of shaper, planer and slotter.
    - 3.2 Type of shapers.
    - 3.3 Type of planers.
    - 3.4 Types of operations performed on shaper, planer and slotter.
    - 3.5 Work holding devices.
    - 3.6 Speeds and feeds in above processes.
  - 4. Broaching (10%)**
    - 4.1 Introduction
    - 4.2 Types of broaching machines – Single ram and duplex ram horizontal type, vertical type pull up, pull down, push down.
    - 4.3 Elements of broach tool, broach tooth details – nomenclature, types, and tool material.
  - 5. Jigs and Fixtures (20%)**
    - 5.1 Importance and use of jigs and fixture
    - 5.2 Principle of location
    - 5.3 Locating devices
    - 5.4 Clamping devices
    - 5.5 Applications of jigs and fixtures
  - 6. Cutting Fluids and Lubricants (10%)**
    - 6.1 Function of cutting fluid
    - 6.2 Types of cutting fluids
    - 6.3 Difference between cutting fluid and lubricant
    - 6.4 Selection of cutting fluids for different materials and operations
    - 6.5 Common methods of lubrication of machine tools.
  - 7. Plastic Processing (20%)**
    - 7.1 Industrial use of plastics, situation where used.
    - 7.2 Compression moulding-principle, and working of compression moulding machine.
    - 7.3 Transfer Moulding
    - 7.4 Injection moulding-principle, working of injection moulding machine.
    - 7.5 Potential and limitations in the use of plastics
-

**PRACTICAL EXERCISES**

**Turning Shop**

- Job 1. Grinding of Single Point Cutting Tool
- Job 2. A composite job involving, boring, taper turning, external thread cutting and knurling.

**Fitting Shop**

- Job 1. Exercise on drilling, reaming, counter boring, counter sinking and tapping
- Job 2. Dove tail fitting in mild steel
- Job 3. Internal Threading by Hand Tapping Practice.

**Machine Shop**

- Job 1. Prepare a V-Block up to  $\pm 0.5$  mm accuracy on shaper machine
- Job 2. Exercise on key way cutting and spline cutting on shaper machine.
- Job 3. Exercise on drilling practice on drilling machine

**Advance Pattern Making Shop**

- Job 1. Advance Exercise on solid pattern.
- Job 2. Advance Exercise on split pattern with provision of core print.
- Job 3. Colour coding of Pattern and preservation of pattern.

**Advance foundry shop**

- Introduction of Cupola Furnace and Oil Fired Furnace.
- Job 1. Advance Exercise in Foundry Shop using core in the mould.
- Job 2. Casting of mould as indicated above under job 1

**Sheet Metal Shop**

- Introduction and demonstration of various types of stakes, snips and marking tools.
  - Job 1. Method for developing the surface of cone.
  - Job 2. Preparation of Conical object like-Funnel.
  - Job 3. Preparation of any utility item like-tray.
-

# MECH. ENGG. FIFTH SEMESTER

## 2014 SCHEME

Code No.	Subject	Study Scheme Period/Week			Evaluation Scheme						Total Marks
		L	T	P	Internal Assessment		External Assessment Exam				
					Theor y	Practic al	Written Paper		Practical		
					Max Marks	Max. Marks	Max. Marks	Hrs	Max. Marks	Hrs	
5.1	Theory of Machines	4	1	-	50	-	100	3	-	-	150
5.2	Refrigeration and Air Conditioning	4	-	2	50	50	100	3	100	3	300
5.3	Inspection & Quality Control	2	-	2	50	50	100	3	100	3	300
5.4	Industrial Engg. & Management Science	4	-	-	50	-	100	3	-	-	150
5.5	CNC Machines & Automation	3	-	4	50	50	100	3	100	3	300
5.6	Manufacturing Technology – III	4	-	-	50	-	100	3	-	-	150
5.7	Workshop Practice – V	-	-	8	-	50	-	-	100	3	150
5.8	<b>Industrial Training</b>	-	-	-	-	50	-	-	100	3	150
**	Student Centred activities	-	-	2	-	-	-	-	-	-	-
	<b>TOTAL</b>	21	1	18	300	250	600	-	500	-	1650

### 5.1 THEORY OF MACHINES

L T P  
4 1 -

#### DETAILED CONTENTS

##### 1. Simple Mechanisms (10%)

- 1.1 Introduction to link, kinematic pair, lower and higher pair, kinematic chain, mechanism, inversions.
- 1.2 Different types of mechanisms (with examples)

##### 2. Power Transmission (25%)

- 2.1 Introduction to Belt and Rope drives
- 2.2 Types of belt drives and types of pulleys
- 2.3 Concept of velocity ratio, slip and creep; crowning of pulleys (simple numericals)
- 2.4 Flat and V belt drive: Ratio of driving tensions, power transmitted, centrifugal tension, and condition for maximum horse power (simple numericals)
- 2.5 Different types of chains and their terminology
- 2.6 Gear terminology, types of gears and their applications; simple and compound gear trains; power transmitted by simple spur gear .

##### 3. Flywheel (20%)

- 3.1 Principle and applications of flywheel
- 3.2 Turning - moment diagram of flywheel for different engines
- 3.3 Fluctuation of speed and fluctuation of energy - Concept only
- 3.4 Coefficient of fluctuation of speed and coefficient of fluctuation of energy
- 3.5 Simple numerical problems on fluctuation of speed and fluctuation of energy

#### **4. Governor (15%)**

4.1 Principle of governor

4.2 Simple description and working of Watt, Porter and Hartnell governor (simple numericals based on watt governor)

4.3 Hunting, isochronism, stability, sensitiveness of a governor

#### **5. Balancing (15%)**

5.1 Principle of balancing

5.2 Introduction to balancing of rotating masses (simple numericals).

5.3 Simple problems related to several masses rotating in different planes.

#### **6. Vibrations (15%)**

6.1 Concept of vibrations and its types - longitudinal, transverse and torsional vibrations (simple numericals)

6.2 Damping of vibrations

6.3 Causes of vibrations in machines, their harmful effects and remedies

#### **INSTRUCTIONAL STRATEGY**

1. Use teaching aids for classroom teaching
  2. Give assignments for solving numerical problems
  3. Arrange industry visits to augment explaining use of various machine components like belt, rope, chain, gear drives, action due to unbalanced masses, brake clutch, governors, fly wheels, cams and gear drives
  4. Video films may be used to explain the working of mechanisms and machine components like clutch, governors, brake etc.
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## **5.2 REFRIGERATION AND AIR CONDITIONING L T P**

**4 - 2**

#### **DETAILED CONTENTS**

#### **1. Principles of refrigeration (10%)**

1.1 Meaning

1.2 Refrigeration Methods

1.3 Units of refrigeration

1.4 Reversed Carnot cycle.

1.5 Heat pump

1.6 Coefficient of performance

1.7 Rating of refrigeration machines.

#### **2. Refrigeration Systems (20%)**

2.1 Air Refrigeration cycle-application and its limitations.

2.2 Vapour Compression Cycle.

2.1.1 Effect of sub-cooling and super heating

2.1.2 Departure of actual vapour compression cycle from theoretical cycle

2.1.3 Effect of varying condensing and suction temperature on coefficient of performance.

2.1.4 Simple mathematical calculation with pressure enthalpy charts.

2.3 Vapour absorption cycle

2.4 Actual Vapour absorption cycle and application

#### **3. Refrigerants (10%)**

3.1 Important properties of a refrigerant.

3.2 Nomenclature of refrigerants.

3.3 Properties and application of commonly used refrigerants such as R-134(a), R22, CO<sub>2</sub>, NH<sub>3</sub> and refrigerant mixture.

3.4 Concept of Ozone Depletion Potential (ODP), Global Warming Potential (GWP)

#### **4. Refrigeration System, Components and Controls (10%)**

4.1 Function, type, specification and constructional details of components such as compressor, condenser, expansion valve (capillary tube, thermostatic expansion valve, low side and high side float valve), evaporator, oil separator, accumulator, header.

4.2 Various controls – Solenoid valve, thermostat, low pressure /high pressure cut out, safety switch.

#### **5. Psychrometry (20%)**

5.1 Various terms – Dry and wet bulb temperature, saturation, dew point, adiabatic saturation, temperature, relative humidity, absolute humidity, humidity ratio.

5.2 Psychrometric chart and its uses.

5.3 Psychrometric processes – sensible heating and sensible cooling, humidification and dehumidification, cooling and dehumidification, heating and humidification, and their representation on psychrometric chart.

5.4 Simple problems.

## **6. Air-conditioning (5%)**

- 6.1 Introduction
- 6.2 Metabolism in human body
- 6.3 Human comfort
- 6.4 Applications of air-conditioning

## **7. Heat Load (10%)**

- 7.1 Various types of loads
- 7.2 Sensible and latent heat load
- 7.3 Load calculations

## **8. Air-conditioning System (10%)**

- 8.1 Study of window air conditioner
- 8.2 Study of split air conditioner
- 8.3 Concept of Central air-conditioning system
- 8.4 Round the year air conditioning system
- 8.5 Air distribution systems, concept of filter, damper, fan, blower, air register and diffuser.

## **9. Miscellaneous Topics (5%)**

- 9.1 Evaporative cooling with example of Desert cooler
- 9.2 Water Chillers and their applications
- 9.3 Green Building Concept
- 9.4 Building Rating

### **LIST OF PRACTICALS**

1. Practice in
    - i) Tube cutting ii) Tube Flaring
    - iii) Tube bending iv) Tube joining
  2. Study of Domestic refrigerator.
  3. Study of water cooler
  4. Study and sketch window type room air-conditioner
  5. Testing of a refrigeration unit to find out;
    - (i) Refrigeration capacity, (ii) Power input, (iii) C.O.P.
  6. (i) Charging refrigerant in an open as well as hermetically sealed units.
    - (ii) Physical detection of leakage of refrigerant by various methods.
  7. Study of experiment ice plant
  8. Visit to an Ice Plant and cold storage.
  9. Visit to a central air-conditioning plant.
  10. Study and sketch of Compressor, Expansion Valve, Solenoid valve, thermostat, H.P.-L.P. switch, oil safety switch, service manifolds and valves, strainers, Driers.
  11. Determination of psychrometric properties of air by sling psychrometer and fan type hygrometer and compare the results with ideal type hygrometer.
  12. Determination of bypass factor of cooling coil.
- 

## **5.3 INSPECTION AND QUALITY CONTROL**

**L T P**

**2 - 2**

### **1. Introduction to Quality (15%)**

Meaning of Quality. Quality Characteristics. Dimensions of Quality – Quality of Design, Quality of Conformance and Quality of Performance. Concept of Variables and Attributes. Quality Assurance. Quality related costs – Prevention Cost, Appraisal Cost, Internal and External Failure Costs. Tools for Quality Improvement – Flow Charts, Cause and Effect Diagram, Check Sheet, Histograms, Scatter Diagrams, Pareto Analysis and Control Chart

### **2. Some Philosophies and their Impact on Quality**

Deming's Wheel. Juran's Quality Trilogy, Crosby's Absolutes of Quality Management. Taguchi's Quality Loss Function

### **3. Statistical Foundation (10%)**

Concept of Random Variable. Measures of Central Tendency and Dispersion. Sampling Process.- Advantages and Disadvantages. Basics of Probability Theory. Probability Distributions – Normal Distribution, Binomial Distribution and Poisson Distribution along with their respective tables.

#### 4. Statistical Quality Control (25%)

Meaning and importance of SQC. Inherent and Assignable sources of Quality Variations. Control Charts for Variables -  $\bar{X}$  and R charts. Control Charts for Attributes – p, np and c charts. Process Capability Analysis – Determination of Statistical Tolerance Limits. Different possibilities of statistically capable and incapable process. Process Capability Indices –  $C_p$  and  $C_{pk}$

#### 5 Acceptance Sampling (20%)

Concept of Acceptance Sampling and comparison with 100% inspection. Different types of Sampling Plans. Operating Characteristic (OC) Curve – Importance and Significance. Concept of Producer's Risk and Consumer's Risk. Concepts of AQL, AOQL, IQL and LTPD.

#### 6. Total Quality Management (20%)

6.1 Principles of TQM: Customer Focus, Commitment by Top Management, Continuous Improvement, Quality Circles, Employee Empowerment, Principle of JIDOKA.

6.2 Quality Audit: Quality Audit Practices. Lead Assessor and Certification

6.3 Six Sigma: Statistical meaning of six sigma. System Improvement Methodology. DMAIC Cycle. Yellow Belt, Green Belt and Black Belt Certification.

#### 7. ISO 9000 and other Quality Standards (5%)

Concept of Quality Standards. ISO 9000 and 14000 standards. Necessity of ISO Certification. Other Quality Standards.

#### List of Practical:

1. Calculation of mean and standard deviation of the quality characteristic for a given set of components.
  2. Construction of  $\bar{X}$  and R chart of the quality characteristic of a given set of components
  3. Construction of p chart of the quality characteristic of a given set of components
  4. Construction of np chart of the quality characteristic of a given set of components
  5. Construction of c chart of the quality characteristic of a given set of components
  6. Construction of OC curve for a given single sampling plan.
- 

#### 5.4 INDUSTRIAL ENGINEERING AND MANAGEMENT SCIENCE

L T P

4 - -

#### *DETAILED CONTENTS*

##### 1. Management Science 10 %

Introduction to Management – Definitions and Characteristics of Management. Leadership - Styles,, Functions and Qualities of a Leader, Manager as a Team Leader. Levels of Management. Managerial Skills – Technical, Conceptual and Human Relation skills. Scientific Management Theory (as given by F. W. Taylor). Principles of Management (as given by Henry Fayol). Functions of Management – Planning, Organizing, Directing, Controlling and Staffing. Systems Approach to Management

##### 2. Organization 10 %

Introduction to Organization. The Process of Organizing. Principles of Organization. Organization Structures – Line, Functional, Line and Staff and Project Organization. Methods of Departmentalization - By Function, Process, Product and Geography. Forms of Business Ownership – Proprietorship, Partnership, Private and Public Enterprises, Cooperative Societies

##### 3. Productivity 10 %

Introduction to Productivity. Types of Productivity Measurement – Concept of Aggregate Productivity. Factors affecting Productivity. Methods of Improving Productivity. Job Evaluation – different methods of Job Evaluation. Wages – Types of Wage Plans. Incentive Schemes. Merit Rating

##### 4. Work Study 25 %

Introduction to Work Study. Method Study – Basic Procedure and Steps involved. Information Collection and recording Techniques in Method Study- Process Chart Symbols, Operation process Chart, Flow Process Chart, Two Handed Process Chart, Multiple Activity Chart, Flow Process Chart, String Diagram and Travel Chart. Critical Examination. Micromotion Study – use of THERBLIGS. SIMO (Simultaneous Motion) Chart – Cyclograph and Chrono Cyclo Graph. Principles of Motion Economy. Work Measurement – Basic Procedure. Techniques in Work Measurement - Time Study, calculation of Standard Time and different Allowances given. Work Sampling (basic calculation) Predetermined Motion Time System (PMTS) Standard Data and its usage. Performance Rating. Concept of Ergonomics



**5. Managerial Economics 10 %**

Law of Demand and Supply. Types of Industrial Assets – Current, Fixed and Intangible Assets and Investments. Liabilities of an industrial organization. Concept of Balance Sheet. Components of Costing. Concept of Depreciation. Concept of Break Even Point

**6. Industrial Psychology 10 %**

Introduction to Psychology. Scope of Industrial Psychology. Motivation - Maslow's Hierarchy of Needs. Human Relations and its importance in Industry. Industrial Relations – Causes of Industrial Disputes. Process of Collective bargaining – Trade Unionism. Workers Participation in Management. Salient features of Industrial Legislations like Factories Act, ESI Act, Boilers Act, Payment of Wages Act, Minimum Wages Act, Workmen Compensation Act and Apprenticeship Act

**7. Human Resource Management 5 %**

Importance of Human Resources in an Industry. Aims and objectives of Human Resource Management. Staff Development - Development of Human Resource Policy in an organization. Manpower Planning – Steps involved. Training – Identification of Training Need, Training Strategies and Methods

**8. Industrial Safety 5 %**

Importance of Industrial safety. Causes of Accidents. Safety Awareness and Safety Drills. Safety Devices. Safety Councils and their roles

**9. Entrepreneurship Development 10 %**

Concept of Entrepreneurship. Need for Entrepreneurship Development. Introduction to Micro, Small and Medium Enterprises (MSME). Entrepreneurial Characteristics – Risk Taking ability. Assessment of Feasibility of the business. – Technical, Economical, Financial, Managerial and Social Feasibilities. Direct and Indirect Taxes. Concept of Cash Flows – NPV and IRR methods. Project Report

**10. Professional and Business Ethics 5 %**

Professional Ethics. Business Ethics. Human Values for Indian Managers. Role of Professional Bodies. Corporate Social Responsibility

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**5.5 CNC MACHINES AND AUTOMATION**

**L T P**

**3 - 4**

**DETAILED CONTENTS**

**1. Introduction**

Introduction to NC, CNC & DNC, their advantages, disadvantages and applications. Basic components of CNC machines, Machine Control Unit, input devices, selection of components to be machined on CNC machines, Axis identification

**2. Construction and Tooling**

Design features, specification of CNC machines, use of slideways, balls, rollers and coatings, motor and leadscrew, swarf removal, safety and guarding devices, various cutting tools for CNC machines, Concept of CNC tool holder, different pallet systems and automatic tool changer system.

**3. System Devices (26%)**

Control System; Open Loop and Closed Loop System, Concept of Actuators, Transducers and Sensors, Tachometer, LVDT, opto-interrupters, potentiometers for linear and angular position, encoder and decoder and axis drives

**4. Part Programming (18%)**

Introduction to Part programming, Basic concepts of part programming, NC words, part programming formats, simple programming for rational components, part programming using canned cycles, subroutines and do loops, tool off sets, cutter radius compensation and tool wear compensation.

**5. Problems in CNC Machines (8%)**

Common problems in CNC machines related to mechanical, electrical and pneumatic, electronic components. Study of common problems and remedies, use of on-time fault finding diagnosis tools in CNC machines.

**6. Automation and NC system (12%)**

Concept of automation, emerging trends in automation, automatic assembly. Overview of FMS, Group technology, CAD/CAM and CIM.

## 7. Robot Technology (12%)

Introduction to robotics, basic robot motion and its applications

### LIST OF PRACTICALS (CNC MACHINES AND AUTOMATION)

1. Study of constructional detail of CNC lathe.
  2. Study of constructional detail of CNC milling machine.
  3. Develop a part programme for following lathe operations and make the job on CNC lathe.
    - Plain turning and facing operation
    - Taper turning operation
    - Circular interpolation.
  4. Develop a part programme for the following milling operation and make the job on CNC milling
    - Plain milling
    - Slot milling
    - Contouring
    - Pocket milling
  5. Preparation of work instructions for machine operator
  6. Preparation of preventive maintenance schedule for CNC machine.
  7. Demonstration through industrial visit for awareness of actual working of FMS in production.
- 

## 5.6 MANUFACTURING TECHNOLOGY - III

L T P

4 - -

### DETAILED CONTENTS

1. Milling (25%)
  - 1.1 Specification and working principle of milling machine
  - 1.2 Classification, brief description and applications of milling machine
  - 1.3 Main parts of column and knee type milling machine
  - 1.4 Milling machine accessories and attachment – Arbors, adaptors, collets, vices, circular table, indexing head and tail stock, vertical milling attachment
  - 1.5 Milling methods - up milling and down milling
  - 1.6 Identification of different milling cutters and work mandrels
  - 1.7 Work holding devices
  - 1.8 Milling operations – face milling, angular milling, form milling, straddle milling and gang milling.
  - 1.9 Cutting parameters
  - 1.10 Indexing on dividing heads, plain and universal dividing heads.
  - 1.11 Indexing methods: direct, Plain or simple, compound, differential and angular indexing, numerical problems on indexing.
2. Grinding (20%)
  - 2.1 Purpose of grinding
  - 2.2 Various elements of grinding wheel – Abrasive, Grade, structure, Bond
  - 2.3 Common wheel shapes and types of wheel – built up wheels, mounted wheels and diamond wheels. Specification of grinding wheels as per BIS.
  - 2.4 Truing, dressing, balancing and mounting of wheel.
  - 2.5 Grinding methods – Surface grinding, cylindrical grinding and centreless grinding.
  - 2.6 Grinding machine – Cylindrical grinder, surface grinder, internal grinder, centreless grinder, tool and cutter grinder.
  - 2.7 Selection of grinding wheel
3. Gear Manufacturing and Finishing Processes (5%)
  - 3.1 Gear hobbing
  - 3.2 Gear shaping
4. Modern Machining Processes (20%)
  - 4.1 Mechanical Process - Ultrasonic machining (USM): Introduction, principle, process, advantages and limitations, applications
  - 4.2 Electro Chemical Processes - Electro chemical machining (ECM) – Fundamental principle, process, applications, Electro chemical Grinding (ECG) – Fundamental principle, process, application
  - 4.3 Electrical Discharge Machining (EDM) - Introduction, basic EDM circuit, Principle, metal removing rate, dielectric fluid,

applications

4.4 Laser beam machining (LBM) – Introduction, machining process and applications

4.5 Electro beam machining (EBM)- Introduction, principle, process and applications

**5. Presses and press tools (10%)**

5.1 Types of presses, their applications, types of press operations.

5.2 Types of dies

5.3 Types of die sets

5.4 Punches

5.5 Pads

5.6 Die clearance

5.7 Stripper plates

5.8 Stops

5.9 Pilots

**6. Metal Finishing Processes (20%)**

6.1 Purpose of finishing surfaces.

6.2 Surface roughness-Definition and units

6.3 Honing Process, its applications

6.4 Description of hones.

6.5 Brief idea of honing machines.

6.6 Lapping process, its applications.

6.7 Description of lapping compounds and tools.

6.8 Brief idea of lapping machines.

6.9 Super finishing process, its applications.

6.10 Polishing

6.11 Buffing

6.12 Concept of electroplating, galvanizing, powder coating

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**5.7 WORKSHOP PRACTICE – V**

**L T P**

**- - 8**

**DETAILED CONTENTS**

General introduction to tools, equipments & machinery used in advance turning shop, machine shop, grinding shop, press & sheet metal shop along with safety precautions.

**ADVANCE TURNING SHOP**

1. Exercises on external turning of various types on lathe.
2. Exercise of boring with the help of boring bar on lathe.
3. Exercises on internal threading on lathe.

**MACHINE SHOP**

1. Produce a rectangular block using a Milling Machine with a side and face cutter
2. Prepare a 'V'- slot on a face using Milling Machine
3. Exercise on Milling Machine with the help of a form cutter

**GRINDING SHOP**

1. Prepare a Job on surface grinding machine
2. Prepare a job on cylindrical grinding machine.
3. Exercise on dressing a grinding wheel.

**PRESS & SHEET METAL SHOP**

1. Exercise in presswork on sheet metal components using a fly press.
2. Exercises in cold working operations on sheet metal cutting, punching, bending, embossing, coining and blanking by using Power Press.
3. Exercises involving use of dies in fabrication of sheet metal parts by power press

## **ADVANCE FITTING SHOP**

1. Radius fitting in mild steel
2. Pipe threading with die

### **Note:**

- \* An experts may be invited from an industry to deliver expert lecturer.
- \*\* Relevant industrial visit may be planned.
- \*\*\* Making a record of exercises/ job completed by the students is a part of the Work for internal evaluation.

**STUDY & EVALUATION SCHEME**  
**THREE YEAR DIP. COURSE IN MECHANICAL ENGINEERING**  
**(2014 Scheme)**

**SIXTH SEMESTER**

Code No.	Subject	Study Scheme Period/Week			Evaluation Scheme						Total Marks
		L	T	P	Internal Assessment		External Assessment Exam				
					Theory	Practical	Written Paper		Practical		
							Max Marks	Max. Marks	Max. Marks	Hrs.	
6.1	Elective-1	5	-	-	50	50	100	3	100	3	300
6.2	Comm. Skills & Personality Development	5	-	-	50	-	100	3	-	-	150
6.3	Machine Design	5	1	-	50	-	100	3	-	-	150
6.4	Metrology & Instrumentation	5	-	2	50	50	100	3	100	3	300
6.5	Operations Management	5	-	-	50	-	100	3	-	-	150
6.6	# Industry Based Project Work	-	-	8	-	100	-	-	200	3	300
									(Viva Voice & Presentation)		
**	Student Centered activities	-	-	4	-	-	-	-	-	-	-
<b>TOTAL</b>		<b>25</b>	<b>1</b>	<b>14</b>	<b>250</b>	<b>200</b>	<b>500</b>	<b>-</b>	<b>400</b>	<b>-</b>	<b>1350</b>

\*\* Student centered activities will include: extension lectures, field visits, Soft Skills, seminars, debates, hobby clubs, library studies, awareness regarding ecology and environment, conservation of energy (Petroleum products, electricity etc), social service camps and other co-curricular activities including games. Advanced planning for each semester has got to be made.

**Elective-1**

6.1-A Automobile Engineering  
6.1-B Power Plant Engineering  
6.1-C Non-Conventional Energy sources } \$ 4 to 5 Industrial / Field visits

**NOTE: - For awarding of Diploma all the papers of Diploma Examinations should be cleared within the course duration plus two years for Regular/Part-time Diploma & Post Diploma Programmes:**

70 % and above	I Division with Distinction
60 % and above and less than 70 %	I Division
50 % and above and less than 60 %	II Division
40 % and above and less than 50 %	Pass

**In order to determine the division in which a candidate shall be placed at the end of the course, the following criteria shall be observed:-**

- (a) **Three year Diploma (I to VI Semester)**  
I year (I & II Semester) - 20%  
II year (III & IV Semester) - 40%  
III year (V & VI Semester) - 40%
- (b) **Vocational Stream (III to VI Semester): (Direct II year admission)**  
II year (III & IV Semester) - 40%  
III year (V & VI Semester) - 60%

**# Practical load for Project in all workshops**

(\$- 4 to 5 Industrial / Field visits)

**RATIONALE**

These days, automobile has become a necessity instead of luxury. The diploma holders in this course are required to supervise production and repair and maintenance of vehicles. For this purpose, knowledge and skills are required to be imparted to them regarding automobile industry as a whole. This subject aims at developing required knowledge and skills in this area.

*Note: Weightage of each topic for external examination is given in the brackets.*

**DETAILED CONTENTS**

- 1. Introduction (5%)**
  - 1.1 Automobile and its development
  - 1.2 Various types of automobiles manufactured in India.
  - 1.3 Layout of chassis
- 2. Power System (15%)**
  - 2.1 Fuel systems for petrol and diesel engines including multi point fuel injection (MPFI), common rail direct injection (CRDI), Fuel injectors and nozzles.
  - 2.2 Comparison of MPFI with carburetor system.
  - 2.3 Concept of double overhead cam, single overhead cam, Twin cam 16 valve technology in 4 cylinder engine.
- 3. Transmission System (30%)**
  - 3.1 Clutch - Function, Constructional details of single plate and multiplate friction clutches, Centrifugal and semi centrifugal clutch, Hydraulic clutch
  - 3.2 Gear Box - Function, Concept of sliding mesh, constant mesh and synchromesh gear box, Torque converter and overdrive,
  - 3.3 Types of drives – Front wheel, Rear wheel, Four Wheel.
  - 3.4 Function of Propeller shaft, Universal joint, Differential and Different types of Rear axles and Front Axles.
  - 3.5 Wheels and Tyres - Types of wheels, Types and specifications of tyres used in Indian vehicles, Wheel balancing
- 4. Steering System (15%)**

Function and principle of Ackerman and Davis steering mechanism, types of steering gear boxes – Worm and nut, worm and wheel, worm and roller, rack and opinion, Power steering system and alignment of wheels – Toe in, toe out, camber, caster, kingpin inclination.
- 5. Braking system (10%)**

Constructional details and working of mechanical, hydraulic brake. Concept of air and vacuum brake, brake adjustment, Introduction to Anti lock brake system and its working.
- 6. Suspension System (10%)**

Function, Types, Working of coil spring, leaf spring. Concept of Air suspension and Shock absorber.
- 7. Auto Electrical System: (15%)**
  - 7.1 Constructional details of lead acid cell battery. Maintenance of batteries, checking of batteries for voltage and specific gravity, Magneto and Battery coil ignition system.
  - 7.2 Concept of Dynamo
  - 7.3 Alternator - Construction and working, Charging of battery by Alternator and Regulator.

**Industrial / Field visits**

## 6.1(B) POWER PLANT ENGINEERING

L T P  
5 - \$

(\$- 4 to 5 Industrial / Field visits)

### RATIONALE

A Diploma holders in mechanical engineering is supposed to manage the power generating plant. Therefore, he must have relevant knowledge and skills about various power plants e.g. steam power plant, nuclear power plant, hydro power plant, diesel engine power plant and gas turbine power plant.

*Note: Weightage of each topic for external examination is given in the brackets.*

### DETAILED CONTENTS

- 1. Introduction (5%)**
  - 1.1 Sources of energy-fuels, atomic nuclei, flowing stream of water, solar rays, wind, terrestrial heat, ocean tides and waves.
  - 1.2 Concept of power station, central and industrial power station, captive power station, classification of power station with respect to prime mover steam, IC engine, gas turbine and hydro power station.
- 2. Steam Power Plant (30%)**
  - 2.1 Steam Power Cycle**
    - 2.1.1 Parameter of a power cycle-thermal efficiency, work ratio, specific stream consumption.
    - 2.1.2 Rankin cycle flow diagram, representation on thermodynamic planes, thermal efficiency, effect of change of condenser pressure, boiler pressure, degree of superheat on thermal efficiency.
    - 2.1.3 Reheat cycle. Simple regenerative cycle.
  - 2.2 Steam Generating Unit**
    - 2.2.1 Elements of a steam power plant, concept of steam generating unit, classification, major components and their functions. Types of super heater, superheat control methods, steam, nuclear and hydro are being set up.
    - 2.2.2 Feed water heating –advantages, types of feed water heaters, Air-preheaters-purpose and types, furnaces-purpose and classification. Pulverized fuel systems, and types of draft systems.
    - 2.2.3 Special features of modern high pressure boilers, Description of representative high pressure boilers.
    - 2.2.4 Performance of a boiler, Efficiency, Equipment evaporation, capacity, heating surface, combustion rate, absorption rate, absorption rate, energy balance.
  - 2.3 Steam Prime Movers**
    - 2.3.1 Concept of a prime mover, steam turbine-advantages as a prime mover, principle elements of a steam –turbine and functions-nozzles, blades, rotor, shaft, casing, shaft seals diaphragm, bearings, steam control, oil system.
    - 2.3.2 Governing of a steam turbines- classification of steam turbines.
    - 2.3.3 Starting and stopping procedures for turbines, precautions during the running.
    - 2.3.4 Performance pf steam turbine, thermal efficiency, efficiency ratio, Mechanical efficiency, steam rate.
  - 2.4 Steam Condensing Equipment**
    - 2.4.1 Functions of condensers, classification, surface condenser components and their functions.
    - 2.4.2 Condenser auxiliaries – hot well, condensate pump, vacuum pump, air ejector, circulating pump, atmospheric relief valve.
    - 2.4.3 Requirement of a good condensing system
    - 2.4.4 Cooling towers – purpose and types.
  - 2.5 Steam Power Station Control**
    - 2.5.1 Effect of load verification of various parameters, Types of control systems – area and centralized, basic components of a control system, compressed air and electrical control systems, controls and instruments in a modern central station control room.
    - 2.5.2 Working of feed water control system and steam temperature control system
    - 2.5.3 Records maintained in a steam power station and their purpose.
- 3. Nuclear Power Plant (20%)**
  - 3.1 Nuclear reactions –fission, fusion, mass defect, binding energy, chain reaction, methods of control of rate of fusion reaction, types of nuclear materials.
  - 3.2 Nuclear reactors – functions of different elements, classification on the basis of different criteria.
  - 3.3 Nuclear power stations employing boiling water vent reactor, candu type reactor –system components, advantages and disadvantages.
- 4. Diesel Engine Power Plant (15%)**

Advantages and disadvantages of diesel engine. Essential elements of diesel power plant. Fuel injection system. Performance testing of diesel engine power plant.
- 5. Gas Turbine Power Plant (10%)**

Brayton cycle-schematic diagram, thermal efficiency. Advantages of gas turbines over diesel engines. Classification of gas turbines, advantages and disadvantages methods of improving thermal efficiency. Important parts and their functions, essential auxiliaries and controls for gas turbines power plant. Fuel for gas turbines.

**6. Hydro Power Plant (10%)**

Advantages, Basic elements, Dams, Head works, water Turbines, Classification of water turbines speed and pressure control, plant auxiliaries, plan operation.

**7. Plant Economy (10%)**

Elements of cost of power, fixed cost, operating cost, factors affecting economy in generation and distribution, Economy in plant selection.

**Industrial / Field visits**



## 6.1(C) Non - Conventional Sources of Energy

L T P  
5 - \$

(\$- 4 to 5 Industrial / Field visits)

### RATIONALE

*Note: Weightage of each topic for external examination is given in the brackets.*

### DETAILED CONTENTS

1. **Introduction:** (15%)  
Fundamentals of energy, Conventional energy sources, their limitations, environmental impacts, Types of non- conventional sources of energy, capacity and expected potential of renewable energy: global and national scenarios, prospects of renewable energy sources.
2. **Solar energy:** (20%)  
Introduction, solar energy available , solar radiations: beam and diffuse, solar constant, solar photo-voltaic cells principle , applications , merits and demerits, working principle of solar thermal flat plate collectors and concentrating collectors and other solar energy applications: solar thermal power plant, solar pond, solar heating, solar water pumping, solar distillation, solar still, solar absorption air-conditioning.
3. **Wind energy:** (10%)  
Introduction , cause of wind , wind power, principle of wind energy conversion, wind turbine ,types, cut in and cut out speed , tip speed ratio, Betz limit, power coefficient ,wind energy limitations.
4. **Biomass energy:** (10%)  
Introduction, Biomass Conversion Technologies, types of biomass based fuels, Biodiesel , Biogas, production, properties and applications.
5. **Small hydro power systems:** (10%)  
Introduction, classification of hydroschemes and water turbines, essential components, efficiency.
6. **Geothermal energy:** (10%)  
Introduction , geothermal sources , advantages, disadvantages and application of geothermal energy, prospects of geothermal energy in India.
7. **Tidal and Wave energy:** (10%)  
Introduction, energy from tides, basic principle of tidal power, advantages , limitations. Wave Energy applications.
8. **Other non-conventional Technolgies:** (15%)  
Fuel cells principle, operationand applications , Hydrogen as alternative fuel for vehicles , Magneto hydro dynamic power conversion.(MHD) , Ocean thermal energy conversion (OTEC).

### Industrial / Field visits

## 6.2 Communication Skills & Personality Development

L T P  
5 - -

### RATIONALE

Diploma holders are support to communicate verbally and in written forms. Further technical & general report writing forms another essential requirement of these people. Keeping in view above requirements, this subject has been added to develop necessary competencies in written and oral communication. Efforts should be made to give practice of communication to the students.

### DETAILED CONTENTS

**Note: Weightage for each topic for external examination is given in the brackets.**

1. **Précis writing:** (10%)  
Précis writing of simple extracts from any English Newspaper.
  2. **Concepts of Communication:** (20%)
    - i) Importance of communication, one way and two way communication, methods of communication – oral, written and non-verbal, barriers to communication and techniques of overcoming the barriers, concept of effective communication, telephonic communication, public speaking and attending interviews.
    - ii) Body language, Eye contact, Dress sense, Posture Gestures, Image Building through verbal & non-verbal, self esteem.
  3. **Correspondence:** (40%)
    - i) Business, official, social letters, letters to press. Inter office communication. Two questions of 10 marks each are to be attempted out of four.
    - ii) Corporate communications, Press release, advertisement, notices, memorandum and Tagline. Two questions of 10 marks each are to be attempted out of four.
  4. **Report Writing:** (15%)
    - i) Technical
    - ii) General
  5. **Practice of writing resume and applications for job.** (10%)
  6. **Importance & benefits of regular reading of Newspapers, writing a brief newspaper clip.** (5%)
-

**RATIONALE**

Diploma holders in mechanical engineering are required to assist in the design and development of prototype and other components. For this, it is essential that he is made conversant with the principles related to design of components and machine and application of these principles for designing. The aim of the subject is to develop knowledge and skills about various aspects related to design of machine components.

*Note: Weightage of each topic for external examination is given in the brackets.*

**DETAILED CONTENTS**

- 1. Introduction to Design (5%)**
  - 1.1 Basic requirements for machine elements
  - 1.2 General design process
  - 1.3 Mechanical properties
  - 1.4 General methods considerations like fatigue, creep, fabrication methods, economic considerations, material selection, ergonomic etc.
- 2. Riveted and Welded Joints (15%)**
  - 2.1 Types of riveted joints
  - 2.2 Possible failure of riveted joints
  - 2.3 Design of Lap and butt type riveted joints (simple cases)
  - 2.4 Strength and efficiency of riveted joints
  - 2.5 Common types of welded joints
  - 2.6 Transverse fillet and parallel fillet welded joints.
- 3. Screw Joints (20%)**
  - 3.1 Introductions to screw and various definitions of screw threads.
  - 3.2 Advantages and disadvantages of screwed joints over riveted and welded joints.
  - 3.3 Common types of screw fastening; through bolt, tap bolt, stud, cap screw, machine screw and set screws
  - 3.4 Designation of screw threads
  - 3.5 Stresses in screw fastenings
  - 3.6 Design of bolts for cylinder cover
- 4. Design of Cotter Joint for Round Rod (20%)**
  - 4.1 Design of cotter
  - 4.2 Design of socket
  - 4.3 Design of spigot
- 5. Design of Knuckle Joint (10%)**
  - 5.1 Design of Rod
  - 5.2 Design of pin
- 6. Shafts, Keys and hooks (15%)**
  - 6.1 Various type of shafts
  - 6.2 Stresses in shafts
  - 6.3 Design of shafts (solid and hollow) subjected to torque and bending moment
  - 6.4 Types of hooks
- 7. Couplings (15%)**
  - 7.1 Definition of term key; its various types
  - 7.2 Splines
  - 7.3 Forces acting on sunk keys
  - 7.4 Shaft couplings and its various types
  - 7.5 Design of flange coupling

- An expert from industry may be invited to deliver lecture.
-

**RATIONALE**

Metrology is the science of measurement. Diploma holders in mechanical engineering are responsible for ensuring process control and quality control by making measurement and inspection of various parameters. For this purpose, knowledge and skills about various measuring instruments is required. Hence this subject. The aim of this subject is to develop knowledge and skills regarding various measuring amongst the students.

*Note: Weightage of each topic for external examination is given in the brackets.*

**DETAILED CONTENTS**

- |   |              |
|---|--------------|
| <b>1. Introduction</b>  | <b>(5%)</b>  |
| 1.1 Meaning of metrology  |              |
| 1.2 Precision and accuracy  |              |
| 1.3 Interchangeability  |              |
| <b>2. Linear Measurement</b>  | <b>(20%)</b> |
| 2.1 Engineering scale   |              |
| 2.2 Vernier Caliper   |              |
| 2.3 Micrometer  |              |
| 2.4 Height gauge and depth gauge                                    |              |
| 2.5 Radius gauge and feeler gauge                                   |              |
| 2.6 Dial indicator  |              |
| 2.7 Comparators (In general use only)                               |              |
| 2.8 Slip gauges   |              |
| <b>3. Angular Measurements</b>                                      | <b>(10%)</b> |
| Working principle and constructional details of                     |              |
| 3.1 Combination set   |              |
| 3.2 Vernier bevel protractor  |              |
| 3.3 Sine bar  |              |
| 3.4 Taper measurement by rollers                                    |              |
| <b>4. Surface Measurements</b>                                      | <b>(10%)</b> |
| 4.1 Straight edge   |              |
| 4.2 Try square  |              |
| 4.3 Surface plate (use and specifications)                          |              |
| <b>5. Limit gauge:</b>  | <b>(5%)</b>  |
| 5.1 Go and No Go gauges   |              |
| <b>6. Thread Measurements</b>                                       | <b>(15%)</b> |
| 6.1 Measurement of thread elements of external and internal threads |              |
| 6.2 Screw pitch gauge   |              |
| 6.3 Screw thread micrometer   |              |
| 6.4 Thread limit gauges   |              |
| <b>7. Gear Tooth Measurement</b>                                    | <b>(5%)</b>  |
| 7.1 Major Dia.  |              |
| 7.2 Pitch Circle Dia (PCD)  |              |
| 7.3 Addendum  |              |
| 7.4 Dedendum  |              |
| <b>8. Surface Finish Measurements</b>                               | <b>(10%)</b> |
| 8.1 Roughness and Waviness  |              |
| 8.2 Various roughness values-CLA value, RMS value, Mean value.      |              |
| 8.3 Surface roughness measuring instrument-principle of working.    |              |
| <b>9. Other Measuring Instruments</b>                               | <b>(10%)</b> |
| 9.1 Autocollimator  |              |
| 9.2 Tool maker's Microscope   |              |
| 9.3 Profile Projector   |              |

**10. Instrumentation (10%)**

Measurement of mechanical quantities such as displacement, vibrations, frequency, pressure, temperature, humidity by electromechanical transducers of resistance; capacitance and inductance type.

**Note:**

- - An expert from industry may be invited to deliver lecture.

**LIST OF PRACTICAL (METROLOGY AND INSTRUMENTATION)**

1. Use of linear measuring instruments like vernier caliper and micrometer.
  2. Use of height gauge and depth gauge
  3. Measuring with the help of combination and bevel protractor
  4. Angle measurement by use of sine bar and slip gauges
  5. Use of slip gauges in measurement of centre distance between two pins.
  6. Use of comparator for measurement
  7. Measurement of taper by standard balls and rollers
  8. Measurement of threads parameters by using toolmakers microscope.
  9. Measurement of gear elements by using gear tooth vernier
  10. Measurement of profile-by-profile projector.
  11. Measurement of surface roughness of a surface.
-

**RATIONALE:**

Diploma holders in mechanical engineering are responsible for controlling production and quality of the product on the shop floor as well as are responsible for production, planning and control. He is also required to supervise erection, installation and maintenance of equipment including material handling and undertake work-study for better utilization of resources. He is also required to lead a team of workers and motivate them towards realization of organizational objectives. For this purpose, knowledge and skills about these topics need to be imparted to them. This subject aims at development of competencies to prepare material. Equipment and production control schedules and maintain required quality levels. In addition, it will also help in developing skills in erection, installation and testing of equipment.

*Note: Weightage of each topic for external examination is given in the brackets.*

**Detailed contents**

- |  |             |
|--|-------------|
| <b>1. Overview of Operations Management</b>  | <b>10 %</b> |
| Concept of the term Operations. Types of Business Operations – Manufacturing, Service and Trading. Types of manufacturing Systems – Mass, Batch and Produce to Order Manufacturing Systems. Necessity and Functions of Production Planning and Control. Concept of Product Life Cycle.   |             |
| <b>2. Plant Location and Layout. Material Handling</b>   | <b>15 %</b> |
| Plant Location decision and its importance. General factors affecting Plant Location decision. Concept of Plant layout, factors affecting Plant Layout. Types of Plant Layouts – Product, Process, Combination and Fixed Position Layouts. Concept of Line Balancing. Introduction and Functions of Material Handling. Different material Handling equipments and their selection. |             |
| <b>3. Forecasting</b>  | <b>20 %</b> |
| Importance of Forecasting. Types of Forecasting – Long, Medium and Short term Forecasting. Concept of Time Series in Forecasting. Techniques in Forecasting –  |             |
| i) Qualitative Techniques – Educated Guess, Executive Committee Consensus, Delphi Method, Sales Force Survey, Customer Survey, Historical Analogy and Market Research.   |             |
| ii) Quantitative Techniques – Moving Average, Weighted Moving Average, Exponential Smoothing and Regression Analysis.  |             |
| iii) Errors Estimates in Forecasting – Mean Absolute Deviation and Standard Error of Estimates.  |             |
| <b>4. Materials Management</b>   | <b>10 %</b> |
| i) Introduction to Inventory Management – Meaning and Objectives (No numerical)  |             |
| ii) Economic order Quantity – Introduction and Graphical Representation  |             |
| iii) ABC Analysis  |             |
| iv) Purchasing Procedure – Objectives of Purchasing, Functions of purchasing department, Steps in Purchasing.  |             |
| v) Introduction to Modern Materials Management Techniques – JIT, KANBAN, Traceability, LIFO, FIFO  |             |
| vi) Material Resource Planning-ERP   |             |
| <b>5. Project Management</b>   | <b>10 %</b> |
| i) Meaning of the term project   |             |
| ii) Importance of Project Management   |             |
| iii) Drawing of simple project networks (Activity On Arrow and Activity On Node)   |             |
| iv) Introduction to CPM and PERT – Critical Time Calculations  |             |
| <b>6. Supply Chain Management</b>  | <b>10 %</b> |
| i) Meaning of a Supply Chain   |             |
| ii) Overview of Supply Chain Management  |             |
| iii) Role of Logistics in Supply Chain Management  |             |
| iv) Make / Buy Decisions   |             |
| v) Introduction to E Commerce  |             |
| vi) Importance of Information Technology in Supply Chain Management  |             |
| <b>7. Production Scheduling</b>  | <b>15 %</b> |
| i) Overview of Production Scheduling   |             |
| ii) Loading – Concept and Types of Loading   |             |
| iii) Types of Production Schedules – Master Production Schedule  |             |
| iv) Techniques of Scheduling – Priority Rules in Sequencing, Sequencing n jobs in one, two and three machines (Johnson's Algorithm)  |             |
| <b>8. Maintenance Management</b>   | <b>10 %</b> |
| i) Meaning and Importance of Maintenance in an industry  |             |

- ii) Types of Maintenance Systems
- iii) Objectives of Maintenance Management – The Bathtub Curve
- iv) Activities involved in Maintenance Management

**RATIONALE**

The practical training cum project work is intended to place students for project oriented practical training in actual work situations for the stipulated period with a view to:

- a) Develop understanding regarding the size and scale of operations and nature of field work in which students are going to play their role after completing the course of study.
- iii) Develop understanding of subject based knowledge given in the class room in the context of its applications at work places.
- iv) Develop first hand experience and confidence amongst the students to enable them to use and apply polytechnic/institute based knowledge and skills to solve practical problem in the world of work.
- v) Develop special skills and abilities like interpersonal skills, communications skills, attitude and values.

This practical training cum project work should not be considered as merely conventional industrial training in which students are sent at work places with minimal supervision. This experience is required to be planned and supervision on regular basis by the polytechnic faculty. For the fulfillment of above objectives, polytechnic may establish close linkage with 8-10 relevant organization for providing such as experience. It is necessary that each organization is visited well in advance and activities to be performed by students are well defined. The chosen activities should be such which are of curricular interest to students and of professional value to industrial /field organization.

Effort should be made to identify actual field problems including repair & maintenance of in-house machine & equipments as project work for the students project selected should not be too complex which is beyond the level of the students. The placement of the students for such a practical cum project work should match with the competency profile of students and the project work assigned to them. Students may be assessed both by industry and polytechnic faculty. The suggested performance criteria is given below:

- 1) Punctuality and regularity
- 2) Initiative in learning /working at site
- 3) Level/proficiency of practical skills acquired
- 4) Ability of solve live practical problems
- 5) Sense of responsibility
- 6) Self expression /communication skills
- 7) Interpersonal skills/ Human relation
- 8) Report writing skills
- 9) Viva Voce & Presentation

The project given to student should be such for which someone is waiting for solution. Some of the suggested project activities are given below:

- i) Projects connected with repair and maintenance of machine parts.
- ii) Estimating and costing projects
- iii) Design of components /parts/Jigs/Fixtures.
- iv) Projects related to quality control
- v) Project work related to increasing productivity
- vi) Project connected with work study
- vii) Project relating to erection, installation, calibration and testing.
- viii) Projects related to wastage reduction
- ix) Any other project as per needs of the industry

**# Practical load for Project in all workshops**





**STUDY & EVALUATION SCHEME**  
**THREE YEAR DIP. COURSE IN MECHANICAL (MAINTENANCE ENGG.)**  
**(2014 Scheme)**

**FIFTH SEMESTER**

SCHEME

Code No.	Subject	Study Scheme Period/Week			Evaluation Scheme						Total Marks
		L	T	P	Internal Assessment		External Assessment Exam				
					Theory	Practical	Written Paper		Practical		
					Max Marks	Max. Marks	Max. Marks	Hrs	Max. Marks	Hrs	
5.1	* Theory of Machines	4	1	-	50	-	100	3	-	-	150
5.2	* Manufacturing Technology – III	4	-	-	50	-	100	3	-	-	150
5.3	* Inspection & Quality Control	2	-	2	50	50	100	3	100	3	300
5.4	* Industrial Engg. & Management Science	4	-	-	50	-	100	3	-	-	150
5.5	* Workshop Practice – V	-	-	8	-	50	-	-	100	3	150
5.6	# I.C. Engines	3	-	2	50	50	100	3	100	3	300
5.7	<b>Industrial Training</b>	-	-	-	-	50	-	-	100	3	150
5.8	Project (Maintenance Related)	-	-	8	-	100	-	-	200	3	300
**	Student Centred activities	-	-	2	-	-	-	-	-	-	-
	<b>TOTAL</b>	17	1	22	300	250	600	-	500	-	1650

\* Common with Mechanical Engg.

# In place of Thermal Engineering-II of Mechanical Engineering.

\*\* Student centered activities will include: extension lectures, field visits, preparation of Major Project, Soft Skills, seminars, debates, hobby clubs, library studies, awareness regarding ecology and environment, conservation of energy (Petroleum products, electricity etc), social service camps and other co-curricular activities including games. Advanced planning for each semester has got to be made.

## 5.1 THEORY OF MACHINES

L T P  
4 1 -

### RATIONALE

A diploma holder in this course is required to assist in the design and development of prototype and other components. For this, it is essential that he is made conversant with the principles related to design of components and machine and application of these principles for designing. The aim of the subject is to develop knowledge and skills about various aspects related to design of machine components.

**NOTE: - Weightage of each topic for external examination is given in the brackets**

### DETAILED CONTENTS

- 7. Simple Mechanisms (10%)**
  - 1.3 Introduction to link, kinematic pair, lower and higher pair, kinematic chain, mechanism, inversions.
  - 1.4 Different types of mechanisms (with examples)
- 8. Power Transmission (25%)**
  - 2.1 Introduction to Belt and Rope drives
  - 2.2 Types of belt drives and types of pulleys
  - 2.3 Concept of velocity ratio, slip and creep; crowning of pulleys (simple numericals)
  - 2.4 Flat and V belt drive: Ratio of driving tensions, power transmitted, centrifugal tension, and condition for maximum horse power (simple numericals)
  - 2.5 Different types of chains and their terminology
  - 2.6 Gear terminology, types of gears and their applications; simple and compound gear trains; power transmitted by simple spur gear
- 9. Flywheel (20%)**
  - 3.6 Principle and applications of flywheel
  - 3.7 Turning - moment diagram of flywheel for different engines
  - 3.8 Fluctuation of speed and fluctuation of energy - Concept only
  - 3.9 Coefficient of fluctuation of speed and coefficient of fluctuation of energy
  - 3.10 Simple numerical problems on fluctuation of speed and fluctuation of energy
- 10. Governor (15%)**
  - 4.4 Principle of governor
  - 4.5 Simple description and working of Watt, Porter and Hartnel governor (simple numericals based on watt governor)
  - 4.6 Hunting, isochronism, stability, sensitiveness of a governor
- 11. Balancing (15%)**
  - 5.3 Principle of balancing
  - 5.4 Introduction to balancing of rotating masses (simple numericals).
  - 5.5 Simple problems related to several masses rotating in different planes.
- 12. Vibrations (15%)**
  - 6.4 Concept of vibrations and its types - longitudinal, transverse and torsional vibrations (simple numericals)
  - 6.5 Damping of vibrations
  - 6.6 Causes of vibrations in machines, their harmful effects and remedies

### **INSTRUCTIONAL STRATEGY**

5. Use teaching aids for classroom teaching
6. Give assignments for solving numerical problems
7. Arrange industry visits to augment explaining use of various machine components like belt, rope, chain, gear drives, action due to unbalanced masses, brake clutch, governors, fly wheels, cams and gear drives
8. Video films may be used to explain the working of mechanisms and machine components like clutch, governors, brake etc.

## 5.2 - MANUFACTURING TECHNOLOGY - III

L T P  
4 - -

### RATIONALE

Diploma holders are responsible for supervising production processes to achieve production targets and for optimal utilization of resources. For this purpose, knowledge about various machining processes and modern machining methods is required to be imparted. Hence the subject of workshop technology.

**Note: Weightage of each topic for external examination is given in the brackets.**

### DETAILED CONTENTS

- 7. Milling (25%)**
- 1.12 Specification and working principle of milling machine
  - 1.13 Classification, brief description and applications of milling machine
  - 1.14 Main parts of column and knee type milling machine
  - 1.15 Milling machine accessories and attachment – Arbors, adaptors, collets, vices, circular table, indexing head and tail stock, vertical milling attachment
  - 1.16 Milling methods - up milling and down milling
  - 1.17 Identification of different milling cutters and work mandrels
  - 1.18 Work holding devices
  - 1.19 Milling operations – face milling, angular milling, form milling, straddle milling and gang milling.
  - 1.20 Cutting parameters
  - 1.21 Indexing on dividing heads, plain and universal dividing heads.
  - 1.22 Indexing methods: direct, Plain or simple, compound, differential and angular indexing, numerical problems on indexing.
- 8. Grinding (20%)**
- 2.8 Purpose of grinding
  - 2.9 Various elements of grinding wheel – Abrasive, Grade, structure, Bond
  - 2.10 Common wheel shapes and types of wheel – built up wheels, mounted wheels and diamond wheels. Specification of grinding wheels as per BIS.
  - 2.11 Truing, dressing, balancing and mounting of wheel.
  - 2.12 Grinding methods – Surface grinding, cylindrical grinding and centreless grinding.
  - 2.13 Grinding machine – Cylindrical grinder, surface grinder, internal grinder, centreless grinder, tool and cutter grinder.
  - 2.14 Selection of grinding wheel
- 9. Gear Manufacturing and Finishing Processes (5%)**
- 3.1 Gear hobbing
  - 3.2 Gear shaping
- 10. Modern Machining Processes (20%)**
- 4.6 Mechanical Process - Ultrasonic machining (USM): Introduction, principle, process, advantages and limitations, applications
  - 4.7 Electro Chemical Processes - Electro chemical machining (ECM) – Fundamental principle, process, applications, Electro chemical Grinding (ECG) – Fundamental principle, process, application
  - 4.8 Electrical Discharge Machining (EDM) - Introduction, basic EDM circuit, Principle, metal removing rate, dielectric fluid, applications
  - 4.9 Laser beam machining (LBM) – Introduction, machining process and applications
  - 4.10 Electro beam machining (EBM)- Introduction, principle, process and applications
- 11. Presses and press tools (10%)**
- 5.10 Types of presses, their applications, types of press operations.
  - 5.11 Types of dies
  - 5.12 Types of die sets
  - 5.13 Punches
  - 5.14 Pads
  - 5.15 Die clearance
  - 5.16 Stripper plates
  - 5.17 Stops
  - 5.18 Pilots
- 12. Metal Finishing Processes (20%)**
- 6.13 Purpose of finishing surfaces.
  - 6.14 Surface roughness-Definition and units
  - 6.15 Honing Process, its applications

- 6.16 Description of hones.
- 6.17 Brief idea of honing machines.
- 6.18 Lapping process, its applications.
- 6.19 Description of lapping compounds and tools.
- 6.20 Brief idea of lapping machines.
- 6.21 Super finishing process, its applications.
- 6.22 Polishing
- 6.23 Buffing
- 6.24 Concept of electroplating, galvanizing, powder coating

### 5.3 INSPECTION AND QUALITY CONTROL

L	T	P
2	-	2

#### RATIONALE

Diploma holders in this course are required to measure and inspect for ensuring quality of product. For this purpose, knowledge and skills about standards of measurement, limits, fits and tolerances, types of inspection and various measuring instruments, SQC & quality standards are necessary.

**Note: Weightage of each topic for external examination is given in the brackets.**

1. **Introduction to Quality** (15%)  
 Meaning of Quality. Quality Characteristics. Dimensions of Quality – Quality of Design, Quality of Conformance and Quality of Performance. Concept of Variables and Attributes. Quality Assurance. Quality related costs – Prevention Cost, Appraisal Cost, Internal and External Failure Costs. Tools for Quality Improvement – Flow Charts, Cause and Effect Diagram, Check Sheet, Histograms, Scatter Diagrams, Pareto Analysis and Control Chart
2. **Some Philosophies and their Impact on Quality** (5 %)  
 Deming's Wheel. Juran's Quality Trilogy, Crossby's Absolutes of Quality Management. Taguchi's Quality Loss Function
3. **Statistical Foundation** (10%)  
 Concept of Random Variable. Measures of Central Tendency and Dispersion. Sampling Process.- Advantages and Disadvantages. Basics of Probability Theory. Probability Distributions – Normal Distribution, Binomial Distribution and Poisson Distribution along with their respective tables.
4. **Statistical Quality Control** (25%)  
 Meaning and importance of SQC. Inherent and Assignable sources of Quality Variations. Control Charts for Variables -  $\bar{X}$  and R charts. Control Charts for Attributes – p, np and c charts. Process Capability Analysis – Determination of Statistical Tolerance Limits. Different possibilities of statistically capable and incapable process. Process Capability Indices –  $C_p$  and  $C_{pk}$
5. **Acceptance Sampling** (20%)  
 Concept of Acceptance Sampling and comparison with 100% inspection. Different types of Sampling Plans. Operating Characteristic (OC) Curve – Importance and Significance. Concept of Producer's Risk and Consumer's Risk. Concepts of AQL, AOQL, IQL and LTPD.
6. **Total Quality Management** (20%)  
 6.4 Principles of TQM: Customer Focus, Commitment by Top Management, Continuous Improvement, Quality Circles, Employee Empowerment, Principle of JIDOKA.  
 6.5 Quality Audit: Quality Audit Practices. Lead Assessor and Certification  
 6.6 Six Sigma: Statistical meaning of six sigma. System Improvement Methodology. DMAIC Cycle. Yellow Belt, Green Belt and Black Belt Certification.
7. **ISO 9000 and other Quality Standards** (5%)  
 Concept of Quality Standards. ISO 9000 and 14000 standards. Necessity of ISO Certification. Other Quality Standards.

### List of Practical:

7. Calculation of mean and standard deviation of the quality characteristic for a given set of components.
8. Construction of  $\bar{X}$  and R chart of the quality characteristic of a given set of components
9. Construction of p chart of the quality characteristic of a given set of components
10. Construction of np chart of the quality characteristic of a given set of components
11. Construction of c chart of the quality characteristic of a given set of components
12. Construction of OC curve for a given single sampling plan.

## 5.4 INDUSTRIAL ENGINEERING AND MANAGEMENT SCIENCE

L	T	P
4	-	-

### RATIONALE

Diploma holders in mechanical engineering are responsible for controlling production and quality of the product on the shop floor as well as be responsible for production, planning and control. He is also required to supervise erection, installation and maintenance of equipment including material handling and undertake work study for better utilization of resources. He is also required to lead a team of workers and motivate them towards realization of organizational objectives. For this purpose, knowledge and skills about these topics need to be imparted to them. This subject aims at development of competencies to prepare material. Equipment and production control schedules and maintain required quality levels. In addition, it will also help in developing skills in erection, installation and testing of equipment.

**Note: Weightage of each topic for external examination is given in the brackets.**

### DETAILED CONTENTS

- 1. Management Science** **10 %**  
Introduction to Management – Definitions and Characteristics of Management. Leadership - Styles,, Functions and Qualities of a Leader, Manager as a Team Leader. Levels of Management. Managerial Skills – Technical, Conceptual and Human Relation skills. Scientific Management Theory (as given by F. W. Taylor). Principles of Management (as given by Henry Fayol). Functions of Management – Planning, Organizing, Directing, Controlling and Staffing. Systems Approach to Management
- 2. Organization** **10 %**  
Introduction to Organization. The Process of Organizing. Principles of Organization. Organization Structures – Line, Functional, Line and Staff and Project Organization. Methods of Departmentalization - By Function, Process, Product and Geography. Forms of Business Ownership – Proprietorship, Partnership, Private and Public Enterprises, Cooperative Societies
- 3. Productivity** **10 %**  
Introduction to Productivity. Types of Productivity Measurement – Concept of Aggregate Productivity. Factors affecting Productivity. Methods of Improving Productivity. Job Evaluation – different methods of Job Evaluation. Wages – Types of Wage Plans. Incentive Schemes. Merit Rating
- 4. Work Study** **25 %**  
Introduction to Work Study. Method Study – Basic Procedure and Steps involved. Information Collection and recording Techniques in Method Study- Process Chart Symbols, Operation process Chart, Flow Process Chart, Two Handed Process Chart, Multiple Activity Chart, Flow Process Chart, String Diagram and Travel Chart. Critical Examination. Micromotion Study – use of THERBLIGS. SIMO (Simultaneous Motion) Chart – Cyclograph and Chrono Cyclo Graph. Principles of Motion Economy. Work Measurement – Basic Procedure. Techniques in Work Measurement - Time Study, calculation of Standard Time and different Allowances given. Work Sampling (basic calculation) Predetermined Motion Time System (PMTS) Standard Data and its usage. Performance Rating. Concept of Ergonomics
- 5. Managerial Economics** **10 %**  
Law of Demand and Supply. Types of Industrial Assets – Current, Fixed and Intangible Assets and Investments. Liabilities of an industrial organization. Concept of Balance Sheet. Components of Costing. Concept of Depreciation .Concept of Break Even Point
- 6. Industrial Psychology** **10 %**  
Introduction to Psychology. Scope of Industrial Psychology. Motivation - Maslow’s Hierarchy of Needs. Human Relations and its importance in Industry. Industrial Relations – Causes of Industrial Disputes. Process of Collective bargaining – Trade Unionism. Workers Participation in Management. Salient features of Industrial Legislations like Factories Act, ESI Act, Boilers Act, Payment of Wages Act, Minimum Wages Act, Workmen Compensation Act and Apprenticeship Act
- 7. Human Resource Management** **5 %**

Importance of Human Resources in an Industry. Aims and objectives of Human Resource Management. Staff Development - Development of Human Resource Policy in an organization. Manpower Planning – Steps involved. Training – Identification of Training Need, Training Strategies and Methods

**8. Industrial Safety 5 %**

Importance of Industrial safety. Causes of Accidents. Safety Awareness and Safety Drills. Safety Devices. Safety Councils and their roles

**9. Entrepreneurship Development 10 %**

Concept of Entrepreneurship. Need for Entrepreneurship Development. Introduction to Micro, Small and Medium Enterprises (MSME). Entrepreneurial Characteristics – Risk Taking ability. Assessment of Feasibility of the business. – Technical, Economical, Financial, Managerial and Social Feasibilities. Direct and Indirect Taxes. Concept of Cash Flows – NPV and IRR methods. Project Report

**10. Professional and Business Ethics 5 %**

Professional Ethics. Business Ethics. Human Values for Indian Managers. Role of Professional Bodies. Corporate Social Responsibility

**5.5 WORKSHOP PRACTICE – V**

L	T	P
-	-	8

**RATIONALE:**

Workshop Practice is included in the curriculum to provide practice on use of different tools and various manufacturing practices. The other objectives of this subject are to develop awareness about safety at work place and ability to work in a team.

**DETAILED CONTENTS**

General introduction to tools, equipments & machinery used in advance turning shop, machine shop, grinding shop, press & sheet metal shop along with safety precautions.

**ADVANCE TURNING SHOP**

4. Exercises on external turning of various types on lathe.
5. Exercise of boring with the help of boring bar on lathe.
6. Exercises on internal threading on lathe.

**MACHINE SHOP**

4. Produce a rectangular block using a Milling Machine with a side and face cutter
5. Prepare a 'V'- slot on a face using Milling Machine
6. Exercise on Milling Machine with the help of a form cutter

**GRINDING SHOP**

4. Prepare a Job on surface grinding machine
5. Prepare a job on cylindrical grinding machine.
6. Exercise on dressing a grinding wheel.

**PRESS & SHEET METAL SHOP**

4. Exercise in presswork on sheet metal components using a fly press.
5. Exercises in cold working operations on sheet metal cutting, punching, bending, embossing, coining and blanking by using Power Press.
6. Exercises involving use of dies in fabrication of sheet metal parts by power press

**ADVANCE FITTING SHOP**

3. Radius fitting in mild steel
4. Pipe threading with die

**Note:**

\* An experts may be invited from an industry to deliver expert lecturer.

\*\* Relevant industrial visit may be planned.

\*\*\* Making a record of exercises/ job completed by the students is a part of the Work for internal evaluation.

## 5.6 I.C. ENGINES

<b>L</b>	<b>T</b>	<b>P</b>
<b>3</b>	<b>-</b>	<b>2</b>

### DETAILED CONTENTS

- 1. Air cycles: (25%)**  
Thermodynamic cycles, concept of reversibility of cycle, thermal efficiency and air standard efficiencies, Carnot cycle-efficiency and its applications. Otto, Diesel and dual combustion cycles- calculation of air standard efficiencies. Effect of compression ratio.
- 2. Principles of IC Engines: (25%)**  
Identification, location, functions and material of main parts, concept of terms like bore, stroke, dead centers, crank-throw, piston, displacement, mean piston speed, compression ratio and clearance volume. Working of two stroke and four stroke petrol and diesel engines-single cylinder and multi cylinder engines, valve timing diagrams, classifications and application of I.C. Engines. Introduction to Rotary Wankle engine.
- 3. Fuel system: (15%)**  
Carburetion: Concept of carburetion, requirements of air fuel mixtures at various load conditions, simple carburetor and its limitations, modifications required in a simple carburetors to overcome the limitations (choke, idling devices, compensating jet, air bleed, solex carburetor, accelerating pump, principle and methods of fuel injection in diesel engines, control of fuel supply and types of nozzles. Working of a fuel injection pump. Fuel filters and mechanical fuel lift pump.
- 4. Ignition system: (10%)**  
Importance of Ignition timing and ignition advance battery ignition and Magneto ignition, Transistorized ignition.
- 5. Cooling of I.C. Engines: (10%)**  
Necessity of cooling, cooling systems, functions of thermostat, anti-freezing mixtures.
- 6. I.C. Engine Testing: (15%)**  
Calculation of I.H.P., B.H.P. and efficiencies – Morse test, Mechanical, thermal, overall and relative efficiencies, heat balance charts.

### **LIST OF PRACTICALS (I.C. ENGINES)**

1. Study of various parts of I.C. Engines by means of old condemned parts.
2. Draw the valve-timing diagram of a Diesel engine-single cylinder.
3. Study the working of a solex carburetor by dismantling oil and locate various circuits.
4. Study the working of a carburetor used in scooter/motor cycle by dismantling it.
5. Study a Micro type fuel injection pump by dismantling it.
6. Study a Micro type fuel injector by dismantling it.
7. Study a Mechanical fuel lift pump by dismantling it.
8. Study a distributor of a 4-Cylinder petrol engine.
9. Locate and draw the cooling circuit of a multi cylinder engine and study the construction of the radiator.
10. Locate and draw the lubricating circuit of a single cylinder diesel engine.
11. To find out the I.H.P. by Morse Test.
12. To find out the B.H.P. and specific fuel consumption of a given engine and draw graph of B.H.P. V/s fuel consumption, specific fuel consumption and Mechanical efficiency.
13. Study the construction and working of reciprocating of compressor.



**STUDY & EVALUATION SCHEME**  
**THREE YEAR DIP. COURSE IN MECHANICAL (MAINTENANCE ENGG.)**  
**(2014 Scheme)**

**SIXTH SEMESTER**

Code No.	Subject	Study Scheme Period/Week			Evaluation Scheme						Total Marks
		L	T	P	Internal Assessment	External Assessment Exam					
						Theory	Practical	Written Paper		Practical	
					Max Marks	Max. Marks	Max. Marks	Hrs.	Max. Marks	Hrs.	
6.1-A to 6.1-C	Elective-1	3	-	4	50	50	100	3	100	3	300
6.2	* Communication Skills & Personality Development	5	-	-	50	-	100	3	-	-	150
6.3	* Machine Design	5	1	-	50	-	100	3	-	-	150
6.4	* Operations Management	5	-	-	50	-	100	3	-	-	150
6.5	* Ref. & Air Conditioning	4	-	2	50	50	100	3	100	3	300
6.6	General Mechanical Maintenance	3	-	6	50	50	100	3	100	3	300
**	Student Centered activities	-	-	2	-	-	-	-	-	-	-
	<b>TOTAL</b>	<b>25</b>	<b>1</b>	<b>14</b>							<b>1350</b>

\* Common with Mechanical Engg.

\*\* Student centered activities will include: extension lectures, field visits, Soft Skills, seminars, debates, hobby clubs, library studies, awareness regarding ecology and environment, conservation of energy (Petroleum products, electricity etc), social service camps and other co-curricular activities including games. Advanced planning for each semester has got to be made.

**Elective-1**

**6.1-A Instrumentation control and Pneumatics**

**6.1-B Electrical and Electronics Maintenance**

**6.1-C Restoration of Parts and Maintenance Management**

**NOTE: - For awarding of Diploma all the papers of Diploma Examinations should be cleared within the course duration plus two years**

**In order to determine the division in which a candidate shall be placed at the end of the course, the following criteria shall be observed:-**

**(a) Three year Diploma (I to VI Semester)**

I year (I & II Semester)	-	20%
II year (III & IV Semester)	-	40%
III year (V & VI Semester)	-	40%

**(b) Vocational Stream (III to VI Semester): (Direct II year admission)**

II year (III & IV Semester)	-	40%
III year (V & VI Semester)	-	60%

**6.1-A INSTRUMENTATION CONTROL AND PNEUMATICS**

<b>L</b>	<b>T</b>	<b>P</b>
<b>3</b>	<b>-</b>	<b>4</b>

**RATIONALE**

Knowledge of instrumentation is essential to a maintenance technician to locate and diagnose faults in machinery and equipment. Pneumatic tools and equipment are now a day widely used, therefore, topics such as pneumatic power unit, controls air cylinder, circularly and combination system air oil are required.

**DETAILED CONTENTS**

1. **(a) TEMPERATURE MEASUREMENTS: (10%)**
  - Mercury-in-Glass thermometers
  - Bimetallic thermometers
  - Pressure- spring thermometers
  - Vapour-pressure thermometers
  - Thermocouples
  - Resistance thermometers
  - Radiation measuring thermometers
- (b) Measurement of pressure, measurement of level and measurement of flow. Introduction to transducers (capacitive and inductive), Tachometers**
2. **TRANSMISSION (10%)**
  - Hydraulic Transmission
  - Pneumatic Transmission
  - Electrical Transmission
  - Time pulse Transmission
3. **CONTROL: (15%)**
  - Calibrations
  - Control elements
  - Control actions
  - Pneumatic control system
  - Electrical control system
  - Step function response
  - On-off-control
  - Proportional control, Proportional plus derivative control
  - Proportional plus derivative plus integral control
  - (P.I.D.) control
  - Proportional band adjustment
  - Adjustable Reset response
  - Adjustable rate response
  - Pneumatic controllers
  - Electric controllers
  - Electronic controller, Digital control (Computer control)
  - Hydraulic controllers
  - Control valves
4. **VIBRATION MEASUREMENT: (5%)**
  - Vibration meter/Monitor
  - Accelerometer
5. **INTRODUCTION TO PNEUMATIC INSTRUMENTATION: (5%)**
  - Basic principles
  - Working
  - Advantages
  - Applications
6. **PNEUMATIC INSTRUMENTS: (10%)**
  - Air gauge (Differential & Non-differential types)
  - Principles, construction and working
  - Advantages and applications
  - Pneumatic comparators
  - Calibration of air gauges
7. **ACCESSORIES: (5%)**
  - Air Filters and Pressure Regulators

- Air gauge Tooling  
Plug gauges  
Valves
8. **PNEUMATIC CONTROLLERS** (10%)  
Principle  
Construction  
Working
9. **COMBINATION SYSTEM – AIR AND OIL:** (15%)  
Application and advantages of combination systems  
Air controlled hydraulic valves  
Oil controlled air valves  
Air control of multiple hydraulic circuits  
Air as a cushion for hydraulic systems
10. Basic – principles of automatic control system-basic elements of automatic control system. Open loop and closed loop system. Concepts of feedback. Block diagram of control system. Time lag, hysteresis, dead time and linearity- self-regulating system. (15%)

**LIST OF PRACTICALS:**

The following are the laboratory exercise:

1. Determine speed response of gas, liquid and Vapour filled pressure spring thermometers at various temperatures.
2. Determine temperature coefficient of resistance using resistance potentiometer.
3. Check accuracy of furnace pyrometers using portable potentiometer.
4. Determine temperature in several furnaces by use of radiation pyrometers.
5. Study of pneumatic power unit.
6. Performance test on compressors.
7. Applications of pneumatic circuits and controls for :
  - i) Holding devices
  - ii) Safety circuits
  - iii) Remotes control

## 6.1-B ELECTRICAL & ELECTRONICS MAINTENANCE

L T P  
3 - 4

### Rationale:

### DETAILED CONTENTS

#### **Introduction to Preventive Maintenance: (10%)**

Principle and planning of preventive maintenance, essentials of preventive maintenance programme, functions of electrical maintenance department. Tools required, loading and unloading of electrical machinery.

#### **Safety precautions & shock treatment: (10%)**

Safety precautions common for all electrical equipments, safety precautions for generation equipments, permit of work, cancellation of permit to work, safety precautions for person incharge, safety precautions for working on L.T. main, safety precautions to be observed while working on domestic installation, I.E. Rules for safety, shock treatment.

#### **Earthing: (15%)**

Types of earthing, methods of earthing, plate earthing, pipe earthing, strip or wire earthing, rod earthing, tap earthing, earth electrode, grounding conductor material, size of grounding conductor, factors influencing earth resistance, methods of reducing earth resistance, inspection and maintenance of earth electrode, test facilities, frequency of measurement of soil resistivity, maintenance of joints of grounding system, Installation and maintenance of steel electrode, preventive maintenance of electric earthing.

#### **Heating and cooling of Electrical Machines: (15%)**

Introduction, energy losses in electrical material, energy losses in electrical conductor, energy losses in magnetic conductor, energy losses in insulating material, Efficiency in Electrical Machines, modes of heat dissipation – Radiation, convection, conduction. Causes of over heating, ventilation of Electrical Machines – Transformer cooling, cooling of rotating Electrical Machines – Synchronous machines, D.C. machines.

#### **Fire and Fire Fighting Equipments: (5%)**

Introduction, cause of fire, precautions to avoid fire, types of fire fighting equipments and their uses, fire Hydrants.

#### **Domestic Installations: (10%)**

Introduction, Testing the electrical installation of a building – testing of insulation resistance to earth, testing of insulation resistance between conduction, continuity or open circuit test, short circuit test, testing of earth continuity path, polarity test, localisation of fault, IE Rules for domestic installations.

#### **Batteries: (10%)**

Introduction, classification, lead acid battery, battery construction, chemical action, Maintenance of lead acid battery, Alkaline-cell, construction, chemical action, characteristics, uses, Maintenance of alkaline cell, Nickel Cadmium batteries uses, chemical action, characteristics summary for battery maintenance, comparison between lead acid and alkaline cell, methods of charging-constant current method, constant voltage method, trickle charging, capacity test for lead acid batteries, information required by the supplier for supply of battery, factors affecting battery life.

#### **Soldering Techniques: (5%)**

Soldering tools, soldering materials, soldering procedures, replacing components, good and bad soldering joints, precautions during soldering, de-soldering techniques.

#### **Passive Components: (5%)**

Test procedure for checking passive components, resistors, capacitors, inductors, transformers and chokes.

PN junction diode, transistor and Thyristor along-with their applications, General idea of oscilloscope, amplifier.

(5%)

#### **Maintenance of: (10%)**

- i) Electronic welding control
- ii) Electronic control circuits for electrical heating
- iii) Electronic counters
- iv) Proximity control of photoelectric Pyrometers.

#### **List of experiments:**

1. Setting, handling of tools and accessories for installing heavy equipment.
2. Commissioning of electrical equipments.
3. Testing of Transfer Oil.
4. Practice in different types of electrical wiring.
5. Disassembling and assembling of Electrical Machines.
6. Study and testing of Starters of A.C. motors.
7. Study and testing of:
  - i) PN Junction diode.
  - ii) Transistor
  - iii) Thyristor
8. Study & operation of controls of oscilloscope.
9. Study & testing of amplifier.
10. Study & testing of:

- i) Electronic welding control
- ii) Electronic control circuits for electrical heating
- iii) Electronic counters
- iv) Proximity control of photoelectric Pyrometers.

## 6.1-C RESTORATION OF PARTS & MAINTENANCE MANAGEMENT

L	T	P
3	-	4

Rationale:

### DETAILED CONTENTS

- 1. Maintenance: (5%)**  
Concept of preventive and breakdown maintenance, general maintenance procedure stepwise. Common maintenance tools, applications, devices, handling facilities and measuring instruments.
- 2. Limits, Fits and Tolerances: (10%)**  
Common fits and tolerances as per IS 919-1963, commonly used fits for various applications. Design tolerances on key width, shaft & housing keyway and diameter, different systems of spline fitting.
- 3. Maintenance stages: (10%)**  
Inspection, small repairs, medium repairs and complete overhaul. Details of work in each stage for maintenance of different metal cutting, metal working and material handling equipments.
- 4. Maintenance stores and control: (5%)**  
Maintenance stores control, Maintenance store rooms, Inventory.
- 5. Restoration of Machine parts: (15%)**  
General restoration of parts likes bed ways and saddle ways of lathe, guide ways of a plain milling machine. Clamping plates and wedges, worn out keyways and Splines, restoration of machine parts by welding, **moralization** and chromium plating.
- 6. Major overhaul of machine tool: (15%)**  
Schedule of complete overhaul of a lathe machine giving the work distribution, planning and repair estimate.  
Common breakdowns in lathe, their causes and remedies, repairing the tailstock, three-jaw chuck, machine spindle and Gearbox.  
Alignment testing of the repaired lathe.
- 7. Maintenance Personal management: (10%)**  
Maintenance trades training, Maintenance supervisory training, Evaluation of maintenance jobs, Incentive payment to maintenance workers.
- 8. Planning and scheduling Maintenance Work: (10%)**  
Work authorization and control. Standard times for maintenance work, Work measurement.
- 9. Critical path method/PERT: (15%)**  
Introduction to CPM/PERT, Sequence of Events. Application of CPM/PERT in over hauling of a lathe.
- 10. Maintenance manuals and reports: (5%)**  
Need for a maintenance manual, Contents of manual, Maintenance manual topics, Manual writing or reporting.

### LIST OF EXPERIMENTS:

1. Reconditioning of bed-ways of a lathe.
2. Reconditioning of knee way, table ways, column way of a milling machine.
3. Dismantling, repairing and assembling of a tailstock dismantling, repairing and assembling of a gearbox of a lathe.
4. Disassembling, repairing and assembling of apron of lathe.
5. Testing of a repaired lathe.
6. Dismantling, repairing and assembling of a drilling machine.
7. Dismantling, repairing

## 6.2 Communication Skills & Personality Development

L T P  
5 - -

### RATIONALE

Diploma holders are support to communicate verbally and in written forms. Further technical & general report writing forms another essential requirement of these people. Keeping in view above requirements, this subject has been added to develop necessary competencies in written and oral communication. Efforts should be made to give practice of communication to the students.

### DETAILED CONTENTS

**Note: Weightage for each topic for external examination is given in the brackets.**

1. **Précis writing:** (10%)  
Précis writing of simple extracts from any English Newspaper.
  2. **Concepts of Communication:** (20%)
    - iii) Importance of communication, one way and two way communication, methods of communication – oral, written and non-verbal, barriers to communication and techniques of overcoming the barriers, concept of effective communication, telephonic communication, public speaking and attending interviews.
    - iv) Body language, Eye contact, Dress sense, Posture Gestures, Image Building through verbal & non-verbal, self esteem.
  3. **Correspondence:** (40%)
    - iii) Business, official, social letters, letters to press. Inter office communication. Two questions of 10 marks each are to be attempted out of four.
    - iv) Corporate communications, Press release, advertisement, notices, memorandum and Tagline. Two questions of 10 marks each are to be attempted out of four.
  4. **Report Writing:** (15%)
    - vi) Technical
    - vii) General
  5. **Practice of writing resume and applications for job.** (10%)
  6. **Importance & benefits of regular reading of Newspapers, writing a brief newspaper clip.** (5%)
-

**RATIONALE**

Diploma holders in mechanical engineering are required to assist in the design and development of prototype and other components. For this, it is essential that he is made conversant with the principles related to design of components and machine and application of these principles for designing. The aim of the subject is to develop knowledge and skills about various aspects related to design of machine components.

*Note: Weightage of each topic for external examination is given in the brackets.*

**DETAILED CONTENTS**

- |            |  |              |
|------------|--|--------------|
| <b>8.</b>  | <b>Introduction to Design</b>  | <b>(5%)</b>  |
| 1.5        | Basic requirements for machine elements  |              |
| 1.6        | General design process   |              |
| 1.7        | Mechanical properties  |              |
| 1.8        | General methods considerations like fatigue, creep, fabrication methods, economic considerations, material selection, ergonomic etc. |              |
| <b>9.</b>  | <b>Riveted and Welded Joints</b>   | <b>(15%)</b> |
| 2.7        | Types of riveted joints  |              |
| 2.8        | Possible failure of riveted joints   |              |
| 2.9        | Design of Lap and butt type riveted joints (simple cases)  |              |
| 2.10       | Strength and efficiency of riveted joints  |              |
| 2.11       | Common types of welded joints  |              |
| 2.12       | Transverse fillet and parallel fillet welded joints.   |              |
| <b>10.</b> | <b>Screw Joints</b>  | <b>(20%)</b> |
| 3.7        | Introductions to screw and various definitions of screw threads.   |              |
| 3.8        | Advantages and disadvantages of screwed joints over riveted and welded joints.   |              |
| 3.9        | Common types of screw fastening; through bolt, tap bolt, stud, cap screw, machine screw and set screws                               |              |
| 3.10       | Designation of screw threads   |              |
| 3.11       | Stresses in screw fastenings   |              |
| 3.12       | Design of bolts for cylinder cover   |              |
| <b>11.</b> | <b>Design of Cotter Joint for Round Rod</b>  | <b>(20%)</b> |
| 4.4        | Design of cotter   |              |
| 4.5        | Design of socket   |              |
| 4.6        | Design of spigot   |              |
| <b>12.</b> | <b>Design of Knuckle Joint</b>   | <b>(10%)</b> |
| 5.3        | Design of Rod  |              |
| 5.4        | Design of pin  |              |
| <b>13.</b> | <b>Shafts, Keys and hooks</b>  | <b>(15%)</b> |
| 6.5        | Various type of shafts   |              |
| 6.6        | Stresses in shafts   |              |
| 6.7        | Design of shafts (solid and hollow) subjected to torque and bending moment   |              |
| 6.8        | Types of hooks   |              |
| <b>14.</b> | <b>Couplings</b>   | <b>(15%)</b> |
| 7.6        | Definition of term key; its various types  |              |
| 7.7        | Splines  |              |
| 7.8        | Forces acting on sunk keys   |              |
| 7.9        | Shaft couplings and its various types  |              |
| 7.10       | Design of flange coupling  |              |

- An expert from industry may be invited to deliver lecture.
-



**RATIONALE:**

Diploma holders in mechanical engineering are responsible for controlling production and quality of the product on the shop floor as well as are responsible for production, planning and control. He is also required to supervise erection, installation and maintenance of equipment including material handling and undertake work-study for better utilization of resources. He is also required to lead a team of workers and motivate them towards realization of organizational objectives. For this purpose, knowledge and skills about these topics need to be imparted to them. This subject aims at development of competencies to prepare material. Equipment and production control schedules and maintain required quality levels. In addition, it will also help in developing skills in erection, installation and testing of equipment.

*Note: Weightage of each topic for external examination is given in the brackets.*

**Detailed contents**

- |  |             |
|--|-------------|
| <b>1. Overview of Operations Management</b>  | <b>10 %</b> |
| Concept of the term Operations. Types of Business Operations – Manufacturing, Service and Trading. Types of manufacturing Systems – Mass, Batch and Produce to Order Manufacturing Systems. Necessity and Functions of Production Planning and Control. Concept of Product Life Cycle.   |             |
| <b>2. Plant Location and Layout. Material Handling</b>   | <b>15 %</b> |
| Plant Location decision and its importance. General factors affecting Plant Location decision. Concept of Plant layout, factors affecting Plant Layout. Types of Plant Layouts – Product, Process, Combination and Fixed Position Layouts. Concept of Line Balancing. Introduction and Functions of Material Handling. Different material Handling equipments and their selection. |             |
| <b>3. Forecasting</b>  | <b>20 %</b> |
| Importance of Forecasting. Types of Forecasting – Long, Medium and Short term Forecasting. Concept of Time Series in Forecasting. Techniques in Forecasting –  |             |
| iv) Qualitative Techniques – Educated Guess, Executive Committee Consensus, Delphi Method, Sales Force Survey, Customer Survey, Historical Analogy and Market Research.  |             |
| v) Quantitative Techniques – Moving Average, Weighted Moving Average, Exponential Smoothing and Regression Analysis.   |             |
| vi) Errors Estimates in Forecasting – Mean Absolute Deviation and Standard Error of Estimates.   |             |
| <b>4. Materials Management</b>   | <b>10 %</b> |
| vii) Introduction to Inventory Management – Meaning and Objectives (No numerical)  |             |
| viii) Economic order Quantity – Introduction and Graphical Representation  |             |
| ix) ABC Analysis   |             |
| x) Purchasing Procedure – Objectives of Purchasing, Functions of purchasing department, Steps in Purchasing.   |             |
| xi) Introduction to Modern Materials Management Techniques – JIT, KANBAN, Traceability, LIFO, FIFO   |             |
| xii) Material Resource Planning-ERP  |             |
| <b>5. Project Management</b>   | <b>10 %</b> |
| v) Meaning of the term project   |             |
| vi) Importance of Project Management   |             |
| vii) Drawing of simple project networks (Activity On Arrow and Activity On Node)   |             |
| viii) Introduction to CPM and PERT – Critical Time Calculations  |             |
| <b>6. Supply Chain Management</b>  | <b>10 %</b> |
| vii) Meaning of a Supply Chain   |             |
| viii) Overview of Supply Chain Management  |             |
| ix) Role of Logistics in Supply Chain Management   |             |
| x) Make / Buy Decisions  |             |
| xi) Introduction to E Commerce   |             |
| xii) Importance of Information Technology in Supply Chain Management   |             |
| <b>7. Production Scheduling</b>  | <b>15 %</b> |
| v) Overview of Production Scheduling   |             |
| vi) Loading – Concept and Types of Loading   |             |
| vii) Types of Production Schedules – Master Production Schedule  |             |
| viii) Techniques of Scheduling – Priority Rules in Sequencing, Sequencing n jobs in one, two and three machines (Johnson's Algorithm)  |             |
| <b>8. Maintenance Management</b>   | <b>10 %</b> |
| v) Meaning and Importance of Maintenance in an industry  |             |

- vi) Types of Maintenance Systems
- vii) Objectives of Maintenance Management – The Bathtub Curve
- viii) Activities involved in Maintenance Management

**RATIONALE**

Diploma holders in mechanical engineering are responsible for supervising production and maintenance of refrigeration and air conditioning systems. For this purpose, knowledge and skills covering principles of refrigeration and air conditioning, various refrigeration and air conditioning system, psychometric are required to be imparted to them. Hence this subject.

*Note: Weightage of each topic for external examination is given in the brackets.*

**DETAILED CONTENTS**

- 2. Principles of refrigeration (10%)**
  - 1.8 Meaning
  - 1.9 Refrigeration Methods
  - 1.10 Units of refrigeration
  - 1.11 Reversed Carnot cycle.
  - 1.12 Heat pump
  - 1.13 Coefficient of performance
  - 1.14 Rating of refrigeration machines.
- 2. Refrigeration Systems (20%)**
  - 2.5 Air Refrigeration cycle-application and its limitations.
  - 2.6 Vapour Compression Cycle.
    - 2.1.5 Effect of sub-cooling and super heating
    - 2.1.6 Departure of actual vapour compression cycle from theoretical cycle
    - 2.1.7 Effect of varying condensing and suction temperature on coefficient of performance.
    - 2.1.8 Simple mathematical calculation with pressure enthalpy charts.
  - 2.7 Vapour absorption cycle
  - 2.8 Actual Vapour absorption cycle and application
- 3. Refrigerants (10%)**
  - 3.5 Important properties of a refrigerant.
  - 3.6 Nomenclature of refrigerants.
  - 3.7 Properties and application of commonly used refrigerants such as R-134(a), R22, CO<sub>2</sub>, NH<sub>3</sub> and refrigerant mixture.
  - 3.8 Concept of Ozone Depletion Potential (ODP), Global Warming Potential (GWP)
- 4. Refrigeration System, Components and Controls (10%)**
  - 4.3 Function, type, specification and constructional details of components such as compressor, condenser, expansion valve (capillary tube, thermostatic expansion valve, low side and high side float valve), evaporator, oil separator, accumulator, header.
  - 4.4 Various controls – Solenoid valve, thermostat, low pressure /high pressure cut out, safety switch.
- 5. Psychrometry (20%)**
  - 5.5 Various terms –Dry and wet bulb temperature, saturation, dew point, adiabatic saturation, temperature, relative humidity, absolute humidity, humidity ratio.
  - 5.6 Psychrometric chart and its uses.
  - 5.7 Psychrometric processes – sensible heating and sensible cooling, humidification and dehumidification, cooling and dehumidification, heating and humidification, and their representation on psychrometric chart.
  - 5.8 Simple problems.
- 6. Air-conditioning (5%)**
  - 6.5 Introduction
  - 6.6 Metabolism in human body
  - 6.7 Human comfort
  - 6.8 Applications of air-conditioning
- 7. Heat Load (10%)**
  - 7.4 Various types of loads
  - 7.5 Sensible and latent heat load
  - 7.6 Load calculations
- 8. Air-conditioning System (10%)**
  - 8.6 Study of window air conditioner
  - 8.7 Study of split air conditioner
  - 8.8 Concept of Central air-conditioning system
  - 8.9 Round the year air conditioning system
  - 8.10 Air distribution systems, concept of filter, damper, fan, blower, air register and diffuser.
- 9. Miscellaneous Topics (5%)**
  - 9.5 Evaporative cooling with example of Desert cooler

- 9.6 Water Chillers and their applications
- 9.7 Green Building Concept
- 9.8 Building Rating

#### **LIST OF PRACTICALS**

- 13. Practice in
    - i) Tube cutting
    - ii) Tube Flaring
    - iii) Tube bending
    - iv) Tube joining
  - 14. Study of Domestic refrigerator.
  - 15. Study of water cooler
  - 16. Study and sketch window type room air-conditioner
  - 17. Testing of a refrigeration unit to find out;
    - (i) Refrigeration capacity, (ii) Power input, (iii) C.O.P.
  - 18. (i) Charging refrigerant in an open as well as hermetically sealed units.
    - (ii) Physical detection of leakage of refrigerant by various methods.
  - 19. Study of experiment ice plant
  - 20. Visit to an Ice Plant and cold storage.
  - 21. Visit to a central air-conditioning plant.
  - 22. Study and sketch of Compressor, Expansion Valve, Solenoid valve, thermostat, H.P.-L.P. switch, oil safety switch, service manifolds and valves, strainers, Driers.
  - 23. Determination of psychrometric properties of air by sling psychrometer and fan type hygrometer and compare the results with ideal type hygrometer.
  - 24. Determination of bypass factor of cooling coil.
-

Rationale:

### DETAILED CONTENTS

1. **Lubrication** (30%)
  - a) **Lubrication principles:** Friction, wear, necessity of Lubrication, types of Lubrication dry Lubrication boundary Lubrication, hydrodynamic Lubrication, Sliding bearings, rolling element bearings, squeeze fillers, materials for bearings, functions of lubricant.
  - b) **Lubricants:** Sources, composition, additions, types of lubricants and their grades, standards tests for physical and chemical properties of lubricants, selecting the lubricant under various conditions.
  - c) **Lubricant application System:** Sight feed, wick, forced, splash, gravity, points of lubrication, frequency, type and precaution for lubrication of machine tools, electric motors, power transmission.
2. **Elements of Mechanical Maintenance:** (20%)  
General features & types of bearing, clutches, brakes and couplings, Belt, chain and gear drives. Different types used in power transmission. Care and maintenance of the above elements, Trouble-Shooting-causes and remedies.
3. **Piping and Hydraulic Systems:** (20%)  
Cutting, bending, joining, sealing and testing of pipes and tubes, Pipe joints-flexible soldered, screwed, flanges, identification of colour codes and markings  
Hydraulic circuits, circuit components, valves for controlling liquids, valve for hydraulic circuits. Changing the hydraulic fluids, Diagnosis, location and rectification of faults. The example of logical fault diagnosis, removal, servicing and refitting of fluid couplings.
4. **Material Handling Equipment:**  
Interplant transportation facilities and handling equipment, types of material handling equipment, Hoisting equipment, General characteristics for surface and overhead transporting facilities, Application of materials handling equipment.  
Hoisting appliance-chains and ropes, pulleys, sprockets and rope drums, Hooks forged, solid triangular, Crane grabs for unit and piece loads, Electric lifting magnets, Arresting gear-shock brakes, Centrifugal brakes, Elevators-cages elevators, stackers.

**List of Practicals:**

1. Use of lubricating oil equipment like oil gun, grease gun etc.
2. Maintaining correct level of oil.
3. Removing old lubricant, clearing and replenishing the machines with fresh lubricant.
4. Study of Pressure lubricating system.
5. Study of gearbox.
6. Bledding of hydraulic breaks system.
7. Clutch installation after removing the cracks.
8. Study of valves in hydraulic system.
9. Familiarization with grading of lubricating oil.
10. Joining a flexible pipe and checking its leakage in any hydraulic system.

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END